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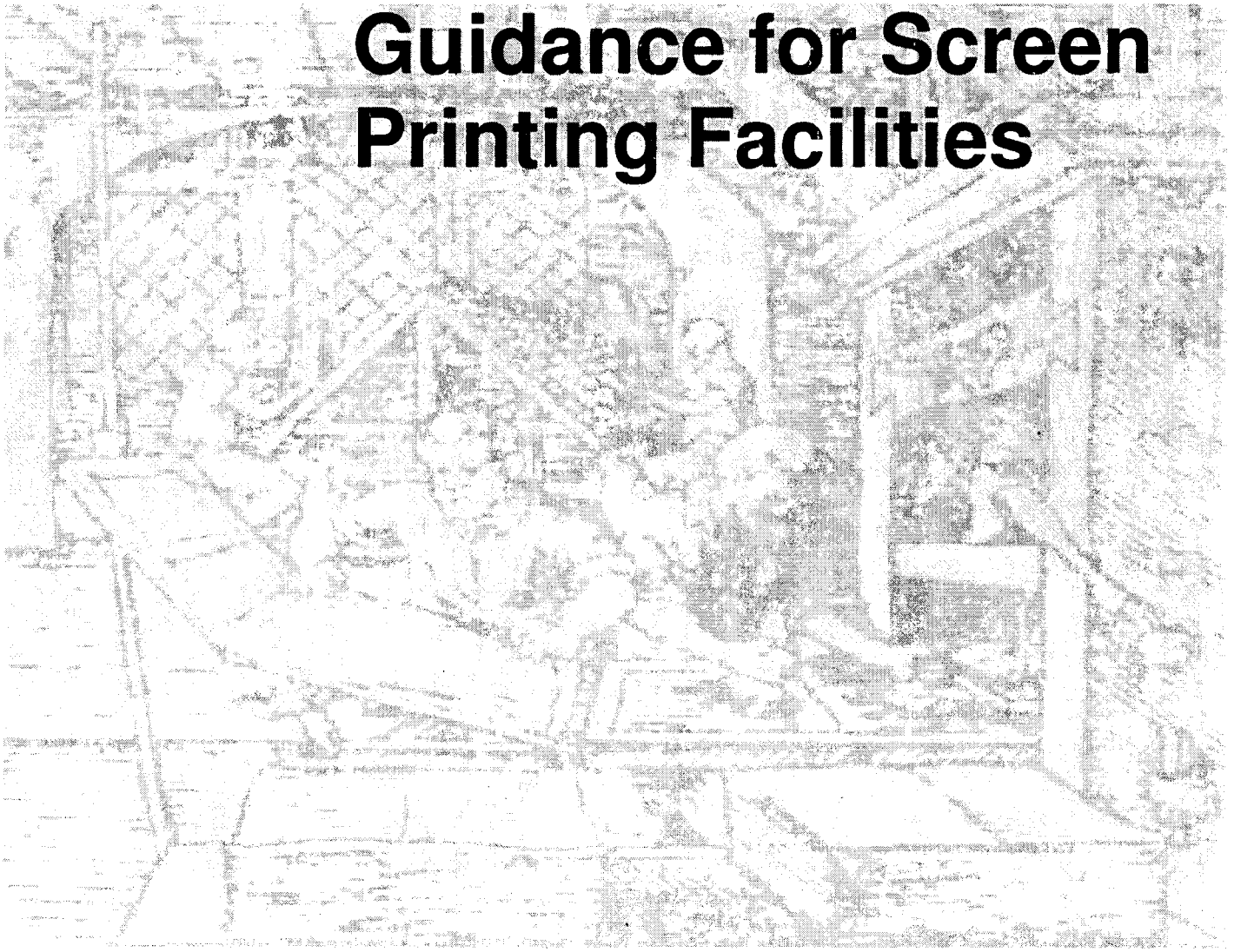

MULTIMEDIA COMPLIANCE/POLLUTION PREVENTION ASSESSMENT GUIDANCE FOR SCREEN PRINTING FACILITIES

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INTRODUCTION

Statement of Goals:

This document was developed to assist field personnel in state, local, and EPA regional offices in conducting multimedia assessments of screen printing facilities. Its primary goal is to enable inspectors to fulfill the traditional role of assessing the compliance status of individual facilities by providing specific information about the screen printing process and a corresponding assessment protocol. However, the manual also focuses on the important goal of overall improved environmental quality by approaching the assessment process with the added objectives of providing compliance assistance to facilities and identifying pollution prevention opportunities.

Section Overview:

To familiarize the inspector with the screen printing industry, Chapter 1 first presents a screen printing industry profile that provides background demographic information on the printing industry in general as well as the screen printing sub-sector. Chapter 2 describes the various processes and materials that are used in the screen printing industry and the wastes that are generated. Actual processes will vary from plant to plant, but this section will introduce the inspector to the fundamental operating principles of a typical facility. Finally, Chapter 3 is an assessment protocol which accompanies the assessment checklist and provides procedural guidance for inspectors regarding regulatory compliance and pollution prevention techniques in the screen printing industry.

CHAPTER 1

SCREEN PRINTING INDUSTRY PROFILE

Screen printing is one of five common printing processes that comprise the printing industry. The industry as a whole is classified as Standard Industrial Classification (SIC) Code Major Group 27—Printing, Publishing, and Allied Industry. Major Group 27 includes firms engaged in printing by one or more common processes, such as screen printing, as well as those entities that perform printing related services, such as bookbinding, typesetting, and photoengraving. It also encompasses firms that publish newspapers, books, and periodicals.

The SIC subgroups under 27 include the following:

271	-	Newspapers
272	-	Periodicals
273	-	Books
274	-	Miscellaneous (e.g., atlases, maps, calendars)
275	-	Commercial Printing
276	-	Manifold business forms
277	-	Greeting cards
278	-	Blankbooks, Looseleaf Binders, and Bookbinding and Related Work
279	-	Service Industries for the Printing Trade (typesetting, platemaking and related services).

Five printing processes currently dominate the U.S. printing industry, accounting for 97 percent of its output. They are, in order of market share, lithography, gravure, flexography, letterpress, and screen printing.[1]

Screen printing is the smallest of the five and differs from other printing processes in that stencils and screens, rather than plates, are used to transfer the image. It is also considered to be the most versatile of the printing processes and is applicable to a wide range of substrate materials, including textiles, plastics, papers, fabrics, wood, leather, glass, and ceramics. Screen printing is also used to manufacture electronic printed circuit boards.

[1]U.S. EPA. *Printing Industry and Use Cluster Profile*. 1994.

There are few restrictions on the size or shape of the screen printed product, as there are for other printing techniques. The process also allows greater thicknesses of ink to be deposited on the substrate, thus creating brighter colors and more durable substrates.

Currently, screen printing comprises approximately 3 percent of the commercial printing industry. However, this figure does not include the large number of "captive in-plant" presses that operate as part of a production line for a variety of products. For example, a toothpaste packaging line might incorporate a screen printing process to print the outside of the toothpaste tube. The exact number of facilities is therefore difficult to determine, but the Screenprinting and Graphic Imaging Association International (SGIA) estimated the total number of facilities at about 40,000 in their 1990 Industry Profile Study. Of the 40,000 screen printing facilities, approximately half are engaged in the printing of all types of textiles, while the other half are engaged in the production of graphic (non-textile) applications, such as decals, labels, membrane switches, and billboards. The average U.S. screen printing facility employs approximately 20 employees represented by 14 production workers, 2 managers or supervisors, 2 sales personnel, and 2 other personnel. Textile facilities tend to be somewhat smaller, employing on average 15 or fewer employees. Large plants with more than 100 employees also exist, but are few in number and account for less than 3 percent of screen printing facilities.[2] The gross sales in 1986 for the screen printing industry were estimated by SGIA at $13.7 billion in their 1990 Industry Profile Survey. More than 50 percent of the facilities have gross sales of less than $1 million.

[2]U.S. EPA. *Printing Industry and Use Cluster Profile.* 1994.

CHAPTER 2

SCREEN PRINTING PROCESSES, MATERIALS, AND WASTES

2.1 General Overview of Printing Processes

Printing processes are identified by the method of image transfer and by the type of image carrier employed. Printed images are transferred to the substrate either directly or indirectly. A substrate is any material upon which ink is deposited. Direct printing processes are gravure, flexography, letterpress, and screen printing. In direct printing, the image is transferred directly from the image carrier to the substrate. In indirect, or offset, printing, the image is first transferred from the image carrier to an intermediate blanket cylinder and then to the substrate. A discussion of individual printing processes and the products associated with those processes is presented below:

- **Lithography** is a form of printing that employs planographic plates, in which the images are neither raised in relief nor depressed. Instead, the flow of ink is controlled by coatings on the plate with different physicochemical properties. Lithography is the predominant printing process in the United States and accounts for approximately 50 percent of all printing applications. Sheet-fed lithography is used for printing books, posters, greeting cards, labels, packaging, advertising flyers, brochures, periodicals, and for reproducing artwork. Web offset lithography is used for periodicals, newspapers, advertising, books, catalogs, and business forms.

- **Gravure** printing makes use of intaglio plates, in which ink is contained in depressions etched onto the surface of the plate. It is used for large volume runs and high speed runs for printing high-quality publications, magazines, catalogs, and advertising. It also has large volume applications in the printing of flexible packaging, paperboard boxes, and labels.

- **Flexography** is a form of letterpress that uses a flexible plastic or rubber plate in a rotary web press. Flexography is a relief printing process, in which the image is raised above the surface of the plate. It is used primarily for packaging (plastic wrappers, corrugated boxes, milk cartons, foil, paper bags) and for imprinting large surface areas. The use of flexographic printing techniques has increased with the amount of packaging used in the United States.

- **Letterpress** printing is the original relief printing process. Web letterpress is used for some printing of newspapers and magazines. However, its use is declining as the use of lithographic printing increases. Sheet-fed letterpress is used for some books, printed stationery, announcements, business cards, and advertising brochures. Because individual changes can be made on a plate without having to redo the entire plate, letterpress is particularly useful for price lists, parts lists, and directories.

- **Screen printing** can print on virtually any substrate, including wood, glass, fabrics, plastics, and metals. It is used for specialty printing such as T-shirts, posters, banners, decals, and wallpapers. This type of printing makes up a small but growing segment of the printing industry. Screen printing is also used to print patterns on electronic circuit boards prior to etching.

Each of the printing processes can be divided into three major steps: prepress, press, and postpress. **Prepress** operations involve a series of steps during which the idea for a printed image is converted into an image carrier (i.e., printing plate, cylinder, or screen). **Press** operations are the actual printing step, in which the ink is transferred via the image carrier to the substrate. Drying or curing of the ink is also usually classified as a press operation. **Postpress** involves various finishing operations to prepare the product for delivery to the customer and cleaning operations to prepare the equipment for the next printing run.

2.2 Screen Printing Process Summary

Screen printing differs from other printing processes primarily in that the image carrier is a screen-mounted stencil, rather than a plate. Screen printing consists of five processes—image processing, stencil and screen preparation, printing, finishing, and screen reclamation—each of which can be identified as part of the prepress, press, or postpress steps. Figure 1 illustrates the sequence of activities involved in a typical operation and notes the raw materials and wastes associated with each process.

- **Prepress.** Prepress operations typically involve **image processing** by photographic processes, followed by **stencil and screen preparation**, in which a stencil is created in the shape of the non-image area and is mounted onto a prepared screen. For multi-color printing, a separate stenciled screen is prepared for each color of ink that will be used.

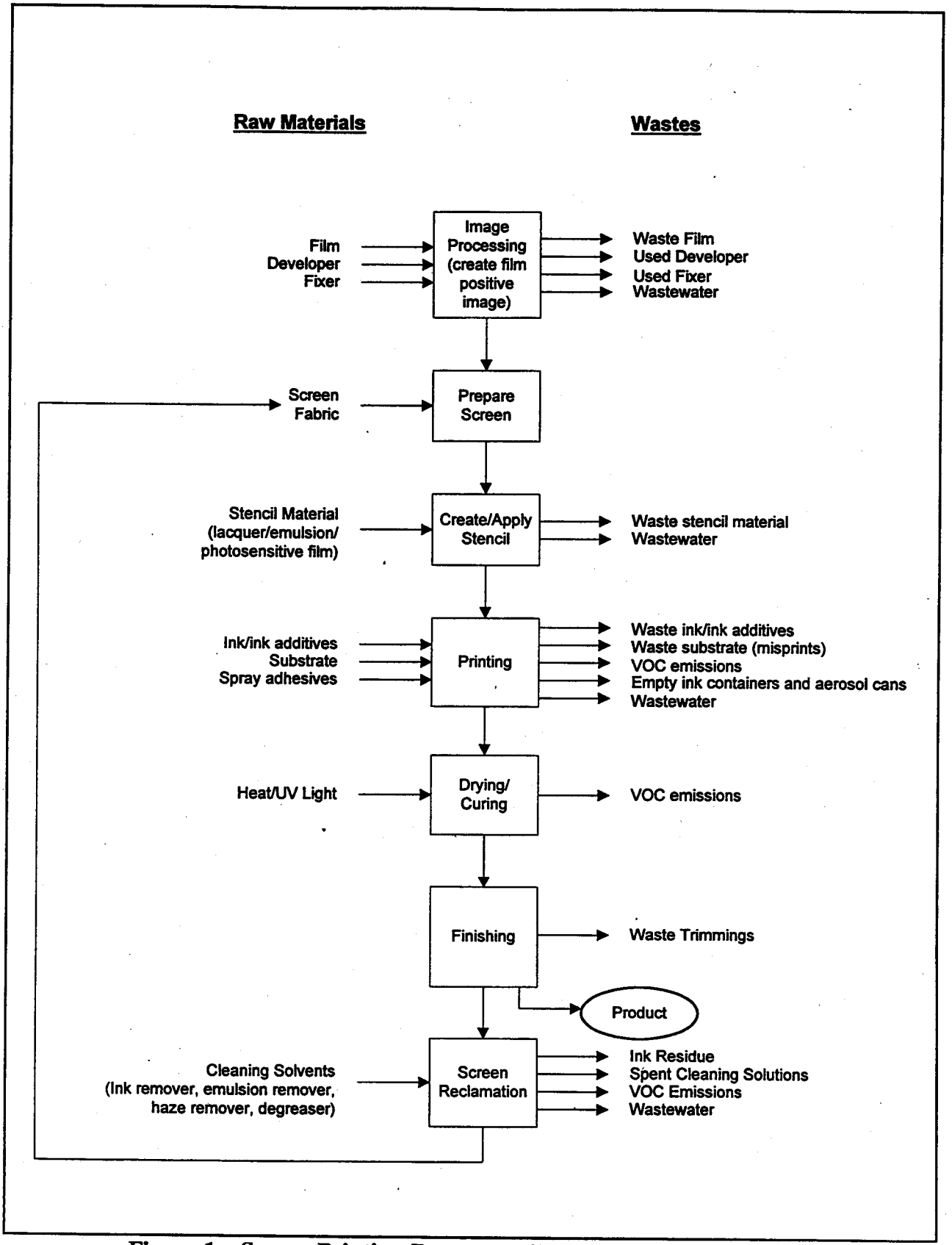

Figure 1. Screen Printing Processes: Raw Materials and Wastes

- **Press.** During the press, or **printing**, step, the substrate (e.g., a T-shirt), is passed under the stenciled screen. A rubber squeegee is swept across the top surface of the screen to press the ink through the areas of the screen that are imaged. In this way, ink is transferred only to the image areas of the substrate. In a multi-color printing press, the substrate is passed in sequence through a series of single-color stenciled screens, one for each color of ink.

- **Postpress.** Postpress operations will involve various **finishing** operations, depending on the product. These finishing operations include assembly, die cutting, or guillotine cutting of screen printed parts. For screen printers, postpress activities also include **reclamation of the screen material** after the printing run.

Primary waste streams of concern in a screen printing facility include the various hazardous compounds found in spent photoprocessing solutions and VOC emissions resulting from the use of inks and cleaning solvents. **Table 1** lists these and other waste streams of concern in a typical screen printing facility and summarizes the environmental issues associated with their control.

The five major processes—image processing, stencil and screen preparation, printing, finishing, and screen material reclamation—are discussed in greater detail in the following sections.

2.3 Image Processing (Prepress)

The screen printing process usually begins with the image processing step to transfer the original camera-ready art into one or more images on black-and-white film. This film positive image is subsequently used to create a photostencil. It can be made of paper, plastic film, or a glass base and is covered with a light sensitive coating. This coating is usually composed of silver halide salts (silver chloride, silver bromide, and silver iodide). To create the film positive, the original art is photographed, which exposes the film to the image.

After the film coating has been exposed, it must be developed. The traditional film developing process consists of immersing the exposed film in a developer bath, a fixer bath, and finally a rinse bath. Immersion in the developer solution converts the silver halides to

Table 1. Screen Printing: Waste Streams of Concern
(adapted from Washington State Department of Ecology, Environmental Management, and Pollution Prevention: A Guide for Screen Printers, 1994)

Waste Stream	Area of Concern	Environmental Concern
Aerosol Cans	Hazardous Waste Air Quality	"Listed" chemicals[1] VOCs
Developer	Hazardous Waste Wastewater	Hydroquinone
Fixer	Hazardous Waste Wastewater	High silver
Haze Remover	Hazardous Waste Wastewater	High pH "Listed" chemicals[2]
Ink Remover	Hazardous Waste Air Quality	"Listed" chemicals VOCs Heavy metals[3]
Emulsion Remover	Wastewater	High pH Reactivity
Parts Washer Solvent	Hazardous Waste	"Listed" chemicals
Scrap Film	Solid Waste	Disposal of recoverable silver
Screen Degreaser	Hazardous Waste Air Quality	"Listed" chemicals[2] VOCs
Waste Screen Emulsion	Wastewater	Suspended Solids
Shop Towels	Hazardous Waste Air Quality	Improper disposal of inks and solvents
Waste Ink	Hazardous Waste Air Quality	"Listed" chemicals VOCs Heavy metals[3]

[1]Listed chemicals include the following chemicals:

acetone
benzene
carbon tetrachloride
chlorinated fluorocarbons
chlorobenzene
cyclohexanone
2-ethosyethanol
ethyl ether
isobutanol
methanol
methylene chloride
methyl ethyl ketone (MEK)
methyl isobutyl ketone (MIBK)
n-butyl alcohol
2-nitropropane
ortho-dichlorobenzene
pyridine
tetrachloroethylene
toluene
trichloroethylene
1,1,1-trichloroethane
1,1,2-trichloroethane
1,1,2-trichloro-1,2,2-trifluoroethane
trichlorofluoromethane
xylene

[2]Formulations for haze remover and screen degreaser that do not contain listed chemicals are now readily available.

[3]Conventional, solvent-based ink systems are more likely to contain some amounts of heavy metals such as barium, cadmium, chromium, or lead.

metallic silver on the film. Developers typically contain benzene derivatives, along with an accelerating agent (to speed up the developing process), a preservative (to reduce oxidation damage to the developer), and a restrainer (to prevent image "fogging").

The developing action is stopped by a fixing bath. Each time a photographic image is immersed in a fixing bath, a small amount of silver enters the bath from the film coating. Insoluble compounds that are formed after the silver concentration reaches a certain level cannot be removed from the coating, so the fixer must be diluted prior to reaching this level. The critical silver concentration for fixing baths is 0.27 ounces per gallon (2 grams/liter).

After the image has been fixed, the film is washed to prevent residual chemicals from reacting and damaging the image. Washes are usually water, with a temperature of 80°F (27°C) and a pH of 4.9 or higher. In some photoprocessing, chemicals are applied to the film coating to reduce or increase the image contrast. Reducers act by oxidizing some of the silver; intensifiers add silver or mercury to the developed silver grains in the coating. Image processing wastes typically include spent developer, spent fixer, contaminated wash water, silver, waste film, and associated photodeveloping chemicals.

As an alternative to the traditional tray system of developing film, most screen printers now use a diffusion transfer film developing unit. These self-contained units require less labor and produce considerably smaller amounts of photographic chemical wastes. The film positive and film negative sheets are fed together through a roller system and automatically exposed to light and to a developer solution. No fixer is needed for this process before the rinsing step.

Silver Recovery from Used Fixer

The silver content in spent fixer has value and can be recovered. On-site recovery of silver is most likely to be practical for larger facilities that generate a significant amount of used fixer. Several methods exist for extracting the silver. The most common methods for recycling small amounts of fixer are electrolytic units and metallic replacement cartridges.

- **Electrolytic Units.** Electrolytic units operate by collecting the positively charged silver ions on a negatively charged cathode. The resulting silver deposits are in a high state of purity and are easily refined and recycled. Electrolytic units are efficient and effective down to a silver concentration of about 100 to 300 parts per million (ppm).

- **Metallic Replacement Cartridges.** Metallic replacement cartridges are hollow canisters that contain steel fibers. When spent fixer is passed through the canister, the silver precipitates out of solution and some iron dissolves in its place. Operating costs are greater than for electrolytic units, but treating silver-bearing wastes with two cartridges in series can, under ideal situations, reduce the silver concentration to about 1 ppm.

The two technologies can also be combined for optimum silver recovery efficiency.

2.4 Stencil and Screen Preparation (Prepress)

The stencil is the image carrier in the screen printing process and can be created out of a photosensitive material. It is affixed to a screen and has a "hole" in the shape of the image to be printed to allow ink to flow through the screen. In the non-image areas, the flow of ink is blocked by the stencil material.

The screen must have a fine weave to allow ink to be deposited smoothly onto the substrate. Polyester fabrics are the most common screen material and have largely replaced the traditional silk screen. Wire mesh and stainless steel screens are also used, but to a lesser degree. After the screen material is stretched taut over a frame and properly tensioned, the stencil can be applied to the screen.

Hand-cut Stencil

The simplest method is to manually cut a stencil of the image out of lacquer film. The cut stencil is bonded to the screen with a liquid adhesive and the paper backing is removed. This process does not require a film positive image, thus avoiding the generation of used fixer and other photoprocessing wastes. Hand-cut stencils are not suitable for use with newer ink systems, however, and their use is becoming increasingly uncommon.

Photosensitive Stencil

Several methods can be used to create a stencil out of a photosensitive material. All of them involve exposing a thin film of a photosensitive material to light (or ultraviolet light) through the film positive image that was created in the image processing step. Light passes through the film positive in the non-image areas and cures the light-sensitive film, rendering it insoluble. The image areas of the film are protected from the light source by the film positive—they can subsequently be dissolved and removed. Three common photosensitive stencil processes are described below:

- **Direct Coating Process.** A common method in which a liquid light-sensitive emulsion is applied to the screen and allowed to dry. The screen is then exposed to a light source through the film positive image, which causes the emulsion in the non-image areas of the screen to cure. Several coats of emulsion can be applied in succession to create more durable stencils. The emulsion in the image area remains water-soluble and can be rinsed off with a pressurized warm water spray, leaving the cured emulsion stencil in place.

- **Indirect Film Process.** A sheet of photosensitive film is exposed to the light source through the film positive, curing the non-image areas. The film must then be developed in a solution that renders the unexposed areas of the film water soluble. This portion of the film is rinsed away, leaving a durable stencil that can then be bonded to the screen.

- **Capillary Film Process.** A sheet of photosensitive film is first laminated to the screen and then exposed to a light source through the film positive. As in the indirect film process, the film must be developed to render the unexposed areas water soluble and then rinsed with water to remove those areas.

Wastewater containing waste stencil material and adhesives is the primary waste generated by the stencil and screen preparation processes.

Innovative Technology: Digital Prepress

The rapid advances in computer technologies in the past decade have resulted in the emergence of digital prepress operations. Digital prepress operations eliminate the costly steps of color separation and photographic production of a film positive image. Instead, the

positive image can be created from a digital file. Digital prepresses now comprise a sizable (and quickly growing) portion of the screen printer image processing market.

Digital images can be created either directly using a software package designed for this purpose, or by using a digital scanner. Digital scanners convert an original proof into a digital file format. Once created, the electronic image can be manipulated into the desired printing format. The final "camera-ready" image is sent to a raster image processor (RIP) which converts the file into a usable format for a digital printer. The printer can then print a high resolution positive image that can be used to create the screen.

The continued development of digital prepress technology has the potential of reducing the amounts of fixer and other photographic wastes generated in the screen printing industry. In addition to digital prepress, digital printers also have the capabilities of printing directly on many types of substrates, either for the purpose of producing proofs for inspection, or for printing the actual product in short run applications.

2.5 Printing Operations (Press)

In the printing step, ink is pressed through the stenciled screen and deposited on the substrate in the shape of the image. The three types of presses commonly used in the screen printing industry are flat-bed presses, cylinder presses, and web presses. Flat-bed presses and cylinder presses are available in varying degrees of automation.

Flat-bed Presses

Flat-bed presses are so named because the bed of such presses are horizontal and parallel to the screen. The substrate to be printed is fed manually or automatically onto the bed, or table. The squeegee and screen assembly comprise the head, which is lowered onto the table during the actual printing process. During printing, a single color of ink is applied to the top of the screen. To deliver the ink through the screen evenly and smoothly to the substrate, a polyurethane squeegee is drawn over the screen. The head assembly is then lifted off the table and the printed substrate is removed and replaced with a new sheet.

Flat-bed presses can be generally classified as clamshell presses or vertical-lift presses, depending on how the head is lifted off the table. The head of a clamshell press is hinged on the rear side of the table and is lifted off by a two-post assembly or a drive mechanism mounted in the rear of the press. The head of a vertical-lift press is not hinged to the table. The entire head is lifted off the table by a two-post cantilever or a four-post assembly.

Carousel presses are a type of flat-bed press used in the textile printing sector. They consist of several small stations, each used for printing a separate color. The stations are arranged in a circular, or carousel, fashion.

Cylinder Presses

Cylinder presses are typically used in operations where speed or fine detail printing are a concern. Unlike a flat-bed press, the substrate is not fixed to a horizontal table. Instead, it is fed across a feedboard and is wrapped around a rotating cylinder. The squeegee and screen are both located above the cylinder. The squeegee remains stationary at the top of the cylinder. During printing, the screen moves horizontally between the squeegee and the cylinder at the same speed at which the cylinder is rotating. Unlike a flat-bed press, there is no need to lift the head assembly off a cylinder, which allows for printing a greater number of impressions per hour.

Web Presses

Web presses are used to print continuous rolls of substrate as opposed to individual sheets. The substrate in such a press is conveyed continuously across a horizontal bed. Paper, plastic, or other types of substrates can be used. Unlike a flat-bed or a cylinder press, the screen of a web press is not flat but is a seamless, rotating metal mesh cylinder within which the ink is stored. The squeegee is a steel bar inside the cylinder screen which is pulled snug against the bottom of the cylinder screen. During printing, the substrate is pulled underneath the rotating cylinder while the steel squeegee delivers ink through the cylinder screen to the substrate.

Printing Process

To begin the printing process, a small "makeready" batch is run to ensure that the images are in good order and are properly aligned. Results from this batch are inspected, and necessary adjustments are made to the press, colors, or inks. Once the results from the makeready batch are satisfactory, the actual production is begun to print the desired number of pieces. Screens generally need to be cleaned occasionally during a production run to remove any ink that may dry on the screen.

In multi-color printing, a separate screen is required for each color of ink to be printed. Up to 64 screens may be required for a single job. Each color of ink must usually be stabilized by partial drying or curing before applying the next color. This is to ensure that different colors of inks do not bleed into each other. In textile printing, however, wet-on-wet printing is a common practice. Special low-bleed inks are used to eliminate the need for drying or curing before applying the next color. Multi-color printing should not be confused with four color process printing, which involves blending four colors of special process printing inks in various thicknesses to create a full multi-color image. Only cyan, magenta, yellow, and black process inks are used. In four color process printing, the number of screens required is limited to four.

Both multi-color printing and four color process printing are used in the screen printing industry.

Ink[3]

Ink systems are typically composed of three components: pigments, resins, and solvents.

Pigments lend color to the ink. Colored (non-black) pigments have traditionally contained heavy metals such as barium, cadmium, chromium, or lead, which are harmful to

[3]Air and Waste Management Association. *Air Pollution Engineering Manual*. 1992.

the environment and to human health. However, recent technological advances have significantly reduced the amount of heavy metals contained in many ink systems. Resins are solids that hold the pigments together and bind them to the substrate. Solvents are needed in some inks to dissolve the resins and pigments so that they are in a fluid state and can be applied smoothly and evenly to the substrate.

Inks can be classified into four categories: solvent-based inks, water-based inks, UV curable inks, and plastisol inks.

Conventional solvent-based inks are still used widely within the screen printing industry and contain organic solvents that dissolve the resins and pigments. After printing, the solvents must be evaporated out of the ink by a heat drying unit. Drying of solvent-based inks releases volatile organic compounds (VOCs) to the atmosphere and can be a primary source of air pollution in a screen printing facility. The amount of VOCs emitted depends on the amount and type of solvents contained in the ink.

Several innovative ink systems have evolved in response to the need for environmentally friendly products. Use of these alternatives to conventional solvent-based ink systems have the potential of eliminating or greatly reducing VOC emissions during the ink drying process. These alternatives are (1) water-based inks, (2) UV curable inks, and (3) plastisol inks.

Water-based inks use water as all or part of their solvent component. Similar to solvent-based inks, these ink systems contain organic pigments, resins, and additives. Water-based ink systems require the used of water-soluble resins and contain up to 65 to 70 percent solids. Typically, water-based inks are used in both textile and graphic applications and have lower VOC concentrations than conventional solvent-based ink systems. Water-based inks should not be confused with water-reducible inks, which contain as little as 10 percent water. These inks can be thinned with water but still may use solvents as the primary resin dissolving agent. Drying of water-reducible inks may still release considerable amounts of VOCs to the atmosphere.

UV curable inks consisting of pigments, monomers, oligomers, additives and modifiers are another type of ink system. They have a solids content of nearly 100 percent (i.e., they contain neither solvents nor water to dissolve the resins) and are cured by exposure to ultraviolet light. Although converting a facility to accommodate their use incurs capital expenses for installation of curing equipment, UV inks have several advantages that make them a promising technology:

- They do not dry when exposed to air and therefore are stable both in storage and on the stencil. Clogging of dried ink on the stencil ceases to be a problem, which eliminates the need to clean the screen during the printing run.
- Curing of UV inks is nearly instant. This makes them particularly appropriate for high speed operations where conservation of drying space can be a significant advantage.
- Curing of UV inks consumes considerably less energy than heat drying processes.
- Since UV inks contain essentially no solvents, VOC emissions are not a significant concern.
- UV inks are non-flammable.

Further development and increased use of UV inks will likely lead to improved production efficiency as well as improved waste minimization.

Plastisol inks also contain nearly 100 percent solids and release very low levels of VOCs. They are composed of two components—polyvinyl chloride (PVC) resins and a plasticizer—that fuse together when heated to 160°C (320°F) in a heat drying unit. Plastisol inks only adhere to porous surfaces and are used primarily in the textile printing sector.

Drying and Curing Units

Most types of inks must be dried after printing. Drying typically takes place in either a flash-curing unit or in a conveyer dryer. A flash-curing unit, also known as a spot-curing unit, contains an infrared heater that heats only the substrate and not the air around it. Curing can often be achieved in only a few seconds with a flash-curing unit. Flash-curing

units are typically used for plastisol inks. A conveyer dryer contains the heat inside a tunnel through which the substrate is moved on a conveyer system. The ink is dried or cured within the tunnel. Conveyor dryers can be either gas or electric powered and are generally used for solvent-based and water-based ink systems.

Substrates printed with UV inks cannot be cured with conventional drying units and must be cured in a UV curing unit instead.

Major wastes generated during printing operations are ink residues, cleaning solvents, substrate misprints from the makeready batch, masking tape, and shop towels. The use of spray adhesives to affix textiles to platens may also generate used aerosol cans. Many of these wastes will contain hazardous compounds that must be disposed of properly.

2.6 Finishing (Postpress)

Finishing refers to the final handling and packaging of the product prior to delivery to the client. The complexity of the finishing process depends greatly on the type of product that has been printed. Screen-printed T-shirts, for example may require little or no finishing. Plastic dashboard parts or electronic printed circuit boards, on the other hand, may require die cutting, knife cutting, and various assembly processes to create the finished product.

2.7 Screen Reclamation (Postpress)

Due to the high price of quality fabrics, screens are cleaned after the production run in order to reclaim them for reuse. The screen reclamation process is of particular interest to the inspector. It is a primary source of air emissions and hazardous wastes in a screen printing facility, as it involves the use of solvent-based cleaning agents that contain highly volatile organic compounds and toxic components. It is also a common practice at many facilities to allow waste cleaning solvents to drain directly into the sewer without proper

pretreatment.[4] The traditional process of screen reclamation consists of applying chemicals in sequence that remove the ink residue, the emulsion, and any haze or ghost images that may remain. A wide variety of chemicals can be used to reclaim screens, including many hydrocarbon solvents, caustics, and oxidizers.

Ink Removal

The first step in screen reclamation is to remove the residual ink from the screen after a printing run. This is generally done press side. Most of the ink can be removed by "carding," or scraping it, from the screen. If possible, the carded ink is returned to the ink container for reuse. Any remaining residual ink must be removed by the application of an ink remover formula. Typically, ink remover is sprayed onto the screen with a small, non-aerosol pump bottle, and rags are used to remove the ink residue. Lacquer thinner, which is composed of methyl ethyl ketone, petroleum distillates, toluene, acetate, and methane, is one common formulation used for ink remover. Some other chemicals used in ink remover formulas are listed in **Table 2**. Chronic dermal or inhalation exposure to many of these organic chemicals may present human health risks.

Major wastes generated in the ink removal process include shop towels and VOC emissions.

Emulsion Removal

To remove the emulsion, the screen is usually moved to the screen reclamation area. The emulsion is removed by application of an emulsion remover formula. Emulsion remover is applied with a brush and worked into the screen to loosen the emulsion. The screen is then rinsed in a washout booth with water, generally at 1,000 psi. Emulsion removers are typically water-based solutions containing a strong oxidizer such as hypochlorite or periodate. These chemicals do not present a significant inhalation risk but do pose a risk of skin and eye irritation and tissue damage, if adequate protective measures are not taken. Wastewater discharges are the major issue associated with the emulsion removal process.

[4]U.S. EPA. *Cleaner Technologies Substitutes Assessment (Draft) - Industry: Screen Printing*. 1994.

Table 2. Traditional Screen Reclamation Chemicals
(Adapted from Cleaner Technologies Substitutes Assessment (Draft)—
Industry: Screen Printing, 1994.)

Use	Chemical	Estimated Market Share (%)
Ink Remover	Lacquer Thinner	40
	Xylene	20
	Mineral Spirits	20
	Acetone	20
Emulsion Remover	Sodium meta periodate	80
	Bleach (Sodium hypochlorite)	10
	Periodic acid	5
	Sodium bisulfate	5
Haze Remover	Sodium hydroxide	25
	Potassium hydroxide	25
	Mixture of xylene, acetone, mineral spirits, and cyclohexanone	20
	Bleach (Sodium hypochlorite)	10
	Mixture of glycol ethers and N-methylpyrrolidone	10
	Mixture of d-limonene and sodium hydroxide	10

Haze Removal

After the ink and emulsion have been removed, a residual haze, or "ghost image," may remain in the image area of the screen. This is more likely to occur if dark solvent-based inks are used, or if the screen is not reclaimed promptly after the printing run. For certain printing applications, such ghost images are unacceptable, and they must be chemically removed before the screen can be reused. A strong base, such as sodium hydroxide (NaOH), is often used a haze remover. Other common chemicals used in haze remover formulas are listed in Table 2. The use of strong bases or strong oxidizers poses a risk of skin and eye irritation or tissue damage, while the use of organic solvents typically presents long-term health risks stemming from chronic dermal or inhalation exposure.

Alternative Screen Reclamation Chemicals

In an effort to minimize the human health and environmental risks associated with the use of many traditional screen reclamation chemicals, manufacturers are developing new products which include various alternative chemicals. These alternative chemicals can be less hazardous to the environment and to facility employees. One manufacturer, for example, has developed an effective ink remover mixture consisting of diethylene glycol series ethers, tripropylene glycol methyl ether, N-methylpyrrolidone, and ethoxylated nonylphenol.[5] An analysis showed that this alternative formula presents considerably lower health risks due to inhalation exposure than either lacquer thinner or acetone.

Practical evaluation of screen reclamation chemicals must of course take into account factors such as cost, usage required, and effectiveness, as well as environmental and health hazards. The EPA publication *Cleaner Technologies Substitutes Assessment (Draft) - Industry: Screen Printing (CTSA)* is a repository of comparative information on a wide variety of traditional and alternative chemicals used in screen reclamation. It includes background information on human health and environmental health hazards of 83 chemical substances, as well as material costs and performance evaluations of various types of formulations and reclamation methods based on testing conducted at screen printing facilities.

Innovative Technologies in Screen Reclamation

A number of methods and technologies have been successfully applied to the screen reclamation process in an effort to reduce or eliminate the amount of hazardous chemicals that must be used. These technologies include high pressure water blasters, solvent recycling systems, and automatic screen washers. Other technologies are also under development. Such pollution prevention alternatives may be especially appropriate in larger screen printing facilities, where the initial capital investment for new equipment can be offset by larger

[5]U.S. EPA. *Cleaner Technologies Substitutes Assessment (Draft) - Industry: Screen Printing.* 1994.

savings in labor or chemical costs. In smaller facilities, the implementation of technologies involving a large capital investment may be more difficult.

- **High Pressure Water Blasters.** High pressure water blasters that deliver streams of water at up to 3,000 psi have been found to be effective, particularly for ink and emulsion removal. They can be used in conjunction with cleaning solvents to reduce the amounts of chemicals that need to be used.

- **Solvent Recycling.** Solvents used in the cleaning process can be recycled in-plant and reused. The recycling process usually consists of filtration followed by distillation and is most often used to recover used ink remover. Filtration removes insoluble particulates such as the solids found in ink. Distillation is a process that vaporizes the solvent and leaves the soluble impurities, such as ink pigments, as a residue in the bottom of a still kettle. The vaporized solvent is passed through a matrix of refrigerated coils and is condensed back to liquid form, purified, and ready for reuse. Solvent recycling can drastically reduce the amount of chemicals that are needed in the screen reclamation process. When the increasing cost of hazardous waste disposal is taken into account, the cost of the equipment for recycling can be paid back in as little as a few months.

- **Automatic Screen Washers.** Fully enclosed automatic screen washers can prevent the release of solvent-based cleaners to the atmosphere during the cleaning process. They are commercially available as ink removers only, or as consolidated units that perform ink removal, emulsion removal, and haze removal in a single unit. Some units include built-in solvent recovery equipment.

- **Additional Emerging Technologies.** Several other environmentally friendly technologies have been identified by EPA's Design for the Environment program as potentially suitable for use in the screen reclamation process. These include:

  - **Baking soda solution sprays**, which have demonstrated limited success in the removal of some types of inks

  - **Dry media blasting** with small particles of wheat starch or baking soda to remove ink and emulsion

  - **Pulse light energy technology**, which exposes screens to intense energy sources in order to vaporize coatings off the fabric

- **Stripping technologies**, in which heat or cryogenic methods are used to loosen coatings, which are subsequently removed by sanding

- **Stencil/emulsion chemistry**, in which the emulsion can be softened by application of an enzyme or gelatin film and then removed with a warm water spray.

These technologies have thus far not been successfully field tested in the screen printing industry, but further research may increase their potential as waste minimization continues to grow in importance.

CHAPTER 3

ASSESSMENT PROTOCOL

The primary purpose of the multimedia assessment protocol for screen printing facilities is to determine compliance with regulations that apply to air emissions, hazardous wastes, industrial wastewater, and the use of toxic substances associated with screen printing processes. Determination of compliance with any regulations that are not specifically associated with the screen printing process (e.g., the TSCA regulations on PCBs) is not a part of this assessment protocol. The assessment protocol also focuses on encouraging pollution prevention and innovative technology by identifying potential pollution prevention and innovative technology opportunities that could move the facility beyond compliance to overall improved environmental quality.

The multimedia assessment will utilize a process-based approach in which the inspector identifies noncompliance with any applicable media-specific or program-specific regulation (air, water, solid waste) as well as pollution prevention and innovative technology opportunities as part of the assessment of individual printing process. The assessment protocol serves as a reference for the conduct of these assessments and includes procedures, an assessment checklist (Appendix A), and an example assessment report (Appendix B). It addresses prepress, press, and postpress operations for screen printing facilities.

The following activities are part of the multimedia compliance assessment protocol:

- Pre-assessment preparation
- On-site activities
  - Opening conference/discussion
  - Facility walk-through
    - Materials storage areas
    - Process areas
    - Waste management areas
    - Records/permits/documentation review
  - Closing conference/discussion

- Preparation of assessment report
- Follow-up activities.

Each of these activities is briefly described in the assessment procedures discussed below. During the assessment, the inspector should generally follow procedures outlined in the EPA Basic Inspector's Training Manual.

3.1 Pre-Assessment Preparation

The inspector should review any existing information on the facility, including any previous noncompliance problems, and determine whether the facility is in a non-attainment area. Using the available information, he/she should complete Section I (General Facility Information) of the Assessment Checklist, which covers general aspects of the regulatory programs to be covered during this assessment (i.e., air, hazardous wastes, wastewater, and use and releases of toxic substances). This information can then be verified during the assessment.

Prior to an assessment, the inspector should become familiar with lists such as (1) the list of EPCRA extremely hazardous substances and their threshold planning quantities, (2) the list of CERCLA hazardous substances and their Superfund reportable quantities, and (3) the EPCRA list of toxic chemicals. Because these lists should also be available for reference (if necessary) during an assessment, the inspector should carry a copy to the facility at the time of the assessment.

3.2 On-Site Activities

Opening Conference/Discussion

During the opening conference/discussion, it is important that the inspector point out that, in addition to the more traditional objective of compliance evaluation, the assessment focuses on providing compliance assistance to the facility and identifying potential pollution prevention and innovative technology opportunities. Thus, assessment questions will address

raw materials used, housekeeping procedures, and process modifications, as well as wastes generated.

The inspector should verify the information in Section I (General Facility Information) of the checklist and obtain any missing information. These questions are intended to obtain an overall general evaluation of the regulations that apply to the facility, including whether the facility currently has any permits. In addition, the printing processes at the facility should be discussed, and a schematic prepared.

Walk-through of Facility

The Assessment Checklist is designed to walk-through the facility in a process-oriented manner, addressing these activities:

- General housekeeping (including raw materials information)
- Image processing
- Stencil and screen preparation
- Printing
- Finishing
- Cleaning/screen reclamation
- Waste handling and management.

For each of these areas, applicable media-specific compliance questions and pollution prevention, innovative technology, and recycling questions are included in the checklist.

- **General Housekeeping/Materials Storage.** General housekeeping/materials storage is a separate section of the checklist, although evaluation of these activities should be ongoing throughout the assessment of the facility. Specifically, the inspector should be observing operation and maintenance and housekeeping throughout the facility walk-through in the storage areas, process areas, and waste management areas. The walk-through of the facility should begin at the receiving area and storage area for raw materials.

- **Process Areas (Image Processing, Stencil and Screen Preparation, Printing, Finishing, Cleaning/Screen Reclamation)**

  For each process or activity listed in the checklist, the inspector should verify the following (using the checklist questions):

  - Description
  - Types and amounts of materials used
  - Types and amounts of wastes generated
  - General condition.

  The checklist contains notes for the inspector regarding compliance issues with respect to individual wastes.

  For each type of waste generated by the process or activity, the inspector should inquire about general or specific pollution prevention techniques and innovative technology as presented in the checklist.

  When assessing the process or activity areas, the inspector should document any evidence of noncompliance that presents an imminent threat to human health or the environment (e.g., leaks or spills of hazardous materials). He/she should take immediate action to notify (1) the facility of the situation and (2) the appropriate program office for follow-up action.

  The checklist is meant only as a guide for questions, and the inspector should ask any other questions to obtain additional information or clarify answers.

  The inspector should note any transfer of wastes from one media to another resulting from process operations.

- **Waste Handling and Management.** The waste handling and management section of the checklist is organized by type of waste being managed and includes wastewater, air emissions, and hazardous wastes. This part of the assessment will generally involve hazardous wastes storage containers, wastewater treatment equipment, and air pollution control equipment. However, silver recovery units, may be assessed as part of image processing, depending on where the silver recovery unit(s) are located in the facility.

  For the waste handling and management areas, the inspector should verify the following (using the appropriate checklist questions):

  - Air and wastewater:
    - -- Any existing permits and permit requirements
    - -- Type of treatment process
    - -- Condition of treatment equipment
    - -- Any noncompliance.

- Hazardous wastes:
  - -- Any existing permit (if TSD facility)
  - -- Condition of storage containers and storage area
  - -- Length of storage
  - -- Waste transportation.

Evaluation of these areas will also involve review of the facility records. For example, if a facility has a wastewater permit, the inspector should review the permit for selected requirements (e.g., limited parameters and self-monitoring frequency) and then assess compliance with these requirements. All violations should be documented.

The inspector should identify any media transfer of waste streams resulting from pollution control/management practices (e.g., generation of sludges from wastewater treatment or generation of scrubber water from air pollution control equipment).

Closing Conference/Discussion

As part of the closing conference/discussion, the inspector should do the following:

- Convey the results of the assessment to the facility including all obvious violations noted. **However, inspectors should refrain from discussing monetary penalty amounts, or whether penalties will be assessed for any violations noted. Inspectors should also make the facility representative aware that any decision with regard to a particular violation is subject to confirmation after evaluation of the inspection findings by the appropriate EPA program offices.**
- Clarify information obtained and ask any outstanding questions
- Discuss in general potential pollution prevention and innovative technology opportunities
- Distribute general or printing-specific compliance assistance literature
- Distribute general or printing-specific pollution prevention or innovative technology literature
- Distribute list of selected references (Appendix C)
- Provide contacts at appropriate agencies that give compliance or technical assistance (e.g., hotlines, technical assistance offices).

The inspector should communicate to the facility that all results are preliminary until follow-up review is completed.

3.3 Preparation of Assessment Report

After the assessment, the inspector should complete the assessment report form in Appendix B. This form contains sections for results of both compliance assessment and identification of pollution prevention and innovative technology opportunities.

Compliance Assessment Sections

The inspector should note any actual and potential violations identified during the assessment.

Pollution Prevention Sections

The inspector should at a minimum provide a list of opportunities identified based on the checklist questions. However, the checklist questions do not cover the full range of potential opportunities for printing processes. If the inspector has additional time and the appropriate references (such as those listed in Appendix C), he/she can identify other potential opportunities that can be listed in the assessment report.

3.4 Follow-Up Activities

After the assessment, the inspector will be responsible for recommending what follow-up actions should be taken. At a minimum, the inspector should provide a report to the facility (example report form shown in Appendix B) that contains a compliance assessment (with list of actual or potential violations) and a list of pollution prevention opportunities (including innovative technology). Additional potential follow-up actions to be taken include the following:

- Referral to specific program office for comprehensive follow-up inspection
- Referral to technical assistance office for follow-up assistance

- Follow-up inspection to determine if facility has implemented pollution prevention techniques.

After conferring with his/her supervisor, the inspector may take one or more of these actions as per State policy depending on the particular findings of the assessment. In some States there are special programs targeted at printing facilities. For example, the Washington Department of Ecology has a program called Snapshots in which inspectors provide compliance assistance during visits to printing facilities and also provide the facility with a summary report containing actions that it should undertake. The State of Washington is planning follow-up inspections to determine if the facilities have completed these actions.

In some situations the inspector may decide that it is appropriate to refer the facility to a media-specific program office because violations that could potentially pose a significant risk to human health or the environment were found during the assessment. In any case, the appropriate follow-up actions should be determined in coordination with the inspector's supervisor and applicable enforcement policies.

APPENDIX A

MULTIMEDIA COMPLIANCE/POLLUTION PREVENTION ASSESSMENT CHECKLIST FOR SCREEN PRINTING FACILITIES

MULTIMEDIA COMPLIANCE/POLLUTION PREVENTION ASSESSMENT CHECKLIST FOR SCREEN PRINTING FACILITIES

Date and Time of Assessment: _____

Facility Name and Address: _____

_____

_____

_____

_____

Facility Contact: _____

(Name, title, and phone) _____

_____

Inspector(s):

Name	Title/Affiliation	Phone Number

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ACRONYMS

BACT	best available control technology
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESQG	conditionally exempt small quantity generator
EHS	extremely hazardous substance
EPCRA	Emergency Planning and Community Right-to-Know Act
ESR	electrolytic silver recovery
HAP	hazardous air pollutant
IPA	isopropyl alcohol
LAER	lowest achievable emission rate
LEPC	Local Emergency Planning Committee
LQG	large quantity generator
MSDS	material safety data sheet
NPDES	National Pollutant Discharge Elimination System
NSR	new source review
P2	pollution prevention
POTW	publicly owned treatment works
PSD	prevention of significant deterioration
PTE	permanent total enclosure
RACT	reasonably available control technology
RCRA	Resource Conservation and Recovery Act
SERC	State Emergency Response Commission
SQG	small quantity generator
VOC	volatile organic compound
WWTP	wastewater treatment plant

GLOSSARY

Best Available Control Technology (BACT)

Technology required pursuant to Part 165 on new major sources and major modifications subject to prevention of significant deterioration (PSD) requirements, which reflect best controls in use taking into account costs and other non-air-quality factors.

Lowest Achievable Emission Rate (LAER)

Degree of control required pursuant to Part 173 on new major sources and major modifications in nonattainment areas; technology must be best in use or most stringent in any State Implementation Plan.

Major Source

Stationary source in an ozone transport region that emits or has the potential to emit at least 50 tons per year of volatile organic compounds (VOCs).

New Source Review (NSR)

Program for pre-construction review of new major sources and major modifications under prevention of significant deterioration (PSD) and nonattainment requirements.

Nonattainment Area Requirements

Program established pursuant to Part D of Title I requiring controls necessary to attain National Ambient Air Quality Standards (NAAQSs) in areas currently not meeting them.

Prevention of Significant Deterioration (PSD)

Program established under Part C of Title I to preserve air quality in areas already meeting National Ambient Air Quality Standards (NAAQSs).

Reasonably Available Control Technology (RACT)

Technology required pursuant to Part 172 to be installed on existing major sources in nonattainment areas; reflects controls EPA has identified in control technique guidelines (CTGs) or other guidance.

I. GENERAL FACILITY INFORMATION

A. General Facility Operations

(1) When did the facility begin operations?

	Yes	No
(2) Have there been previous printing operations at this location?		

(3) What are the facility's hours of operation? _____

(4) Describe the printing system.

Complete schematic on page A-2 with raw materials input and wastes generated for each process/activity. If possible, obtain a copy of a schematic or process diagram from the facility.

Complete Table 1 (pages A-3 and A-4) by listing wastes generated by process/activity, quantity generated, disposal method, and whether the waste is hazardous or nonhazardous.

I. GENERAL FACILITY INFORMATION (Continued)

A. General Facility Operations (Continued)

Schematic of Printing Operations (Example Diagram Included)

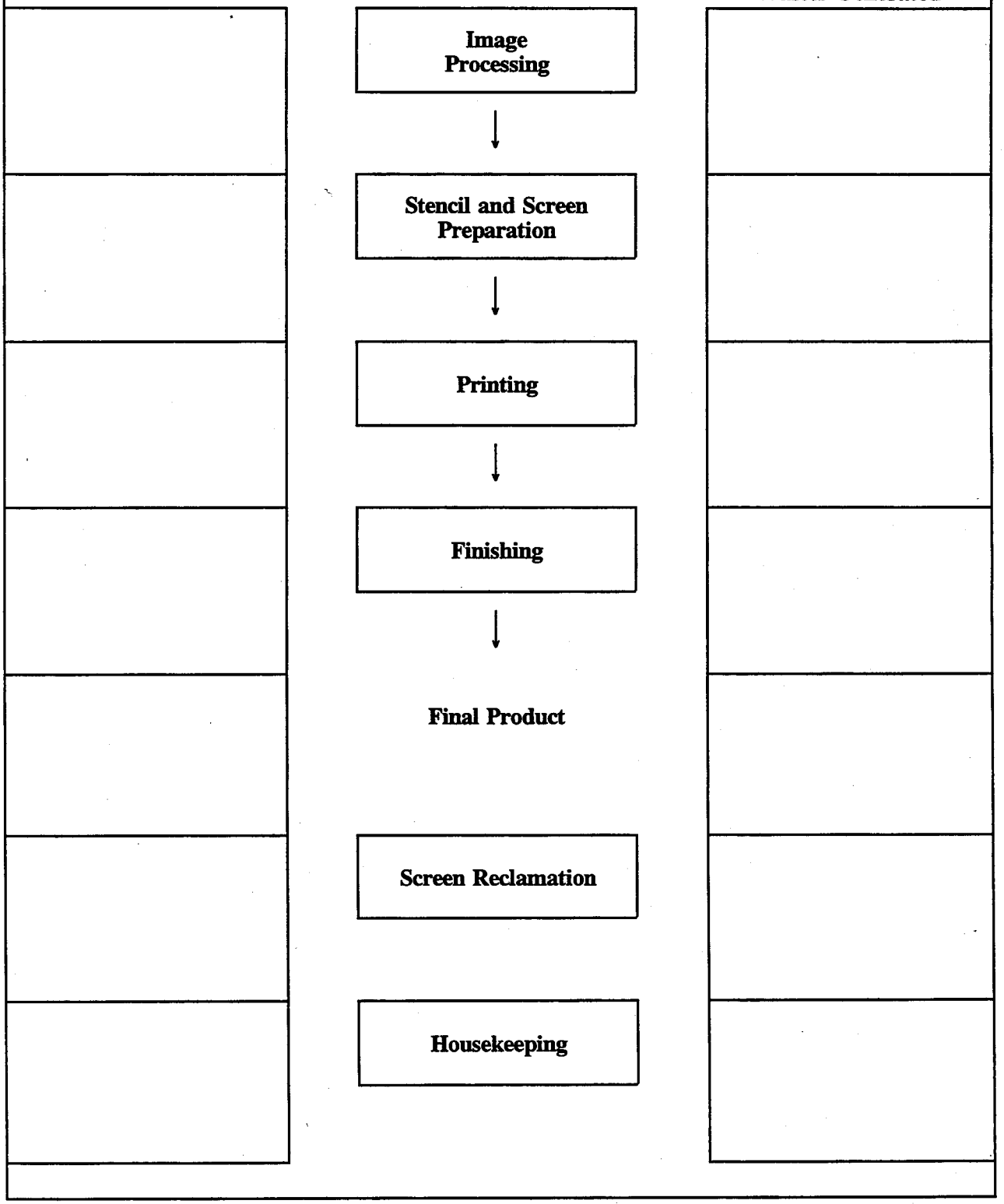

Table 1. Summary of Wastes Generated, Quantity, and Disposal Methods

Type of Wastes Generated (including EPA and State code if applicable)	Quantity per Month Generated	Disposal Method(s)	Hazardous or Non-hazardous?
General Housekeeping/Materials Storage			
Image Processing			
Stencil Construction and Screen Preparation			

Table 1. Summary of Wastes Generated, Quantity, and Disposal Methods (Continued)

Type of Wastes Generated (including EPA and State code if applicable)	Quantity per Month Generated	Disposal Method(s)	Hazardous or Non-hazardous?
Printing			
Finishing			
Cleaning/Screen Reclamation			

Total Hazardous Waste Generated Per Month _____

Total Acute Hazardous Waste Generated Per Month _____

I. GENERAL FACILITY INFORMATION (Continued)

A. General Facility Operations (Continued)

	Yes	No
(5) Has a pollution prevention or waste minimization plan been developed by the facility?		

If yes, under which programs?

	Yes	No
(6) Has the facility evaluated which wastes are probable candidates for reductions through pollution prevention activities (e.g., has the facility identified or implemented any process chemical changes to reduce air emissions or hazardous waste generation)?		

If yes, list the wastes and describe pollution prevention activities currently being undertaken.

(7) What type of training activities are conducted at the facility?

	Yes	No
(8) Have employees been trained in the fundamentals of pollution prevention?		

B. Wastewater

(1) Does the facility discharge wastewater into:

Surface Water? ☐ Receiving Stream _____

NPDES Permit No. _____

Municipal Sewer? ☐ Name of WWTP _____

Permit No. (if applicable) _____

Subsurface System? ☐ Type _____

I. GENERAL FACILITY INFORMATION (Continued)

B. Wastewater (Continued)

(2) In the following table, indicate type of wastewater discharged, disposal method, and volume:

Wastewater Type	Surface Water	Municipal Sewer	Disposal Subsurface System	Other
Sanitary				
Process(es)				
Noncontact Cooling				
Storm Water				
Other				
Total				

Notes to Inspector:

If the facility does not know the volume of its sanitary waste discharge, it can be estimated by multiplying the number of employees by the residential equivalent units estimate of 25-35 gallons per day per worker.

Storm water discharges only apply to outdoor, exposed industrial areas. Industrial areas are defined as areas where material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, or industrial machinery are exposed to storm water.

C. Air

	Yes	No
(1) Is the facility located in an area designated as nonattainment for the National Ambient Air Quality Standard for Ozone?		

	Yes	No
(2) Is the facility designated as a major source of:		
• VOCs?		
• NO_x?		
• Hazardous Air Pollutants (HAPs)?		

I. GENERAL FACILITY INFORMATION (Continued)

C. Air (Continued)

	Yes	No
(3) If yes, is the facility subject to applicable Reasonably Available Control Technology (RACT) requirements?		

(4) Indicate types and estimated amounts of air emissions (e.g., VOCs) from various sources.

Type of Emissions (e.g., VOCs)	Source (e.g., Cleaning Tank)	Amount

Notes to Inspector:

The mass balance method can be used to estimate VOC emissions. An example of a mass balance to calculate VOC emissions is presented below:

Example: A printer's chemical usage for one year is ink (10,000 lbs, 15% VOC content) and ink remover (1,000 gallons, 50% VOC and specific gravity 0.7). 100 lbs of ink are disposed of in waste shipments.

First, determine how many pounds of each chemical are used.

ink = 10,000 lbs
ink remover = 1,000 gallons x (0.7 x 8.34 lbs/gal) = 5,838 lbs

Next, determine the annual amount of VOCs used by multiplying the pounds used by the VOC fraction.

ink = 10,000 lbs x 0.15 = 1,500 lbs
ink remover = 5,838 lbs x 0.5 = 2,919 lbs

Emissions of VOCs can now be estimated by subtracting the disposed amount (or the amount remaining with the product) from the amount used.

discarded ink = 100 lbs x 0.15 = 15 lbs
1,500 lbs (from second step) - 15 lbs = 1,485 lbs

ink remover disposed of in cleaning cloths = 500 lbs
2,919 (from second step) - (500 lbs x 0.5) = 2,669 lbs

Total VOC emissions are 1,485 lbs (ink) + 2,669 (ink remover) = 4,154 lbs

I. GENERAL FACILITY INFORMATION (Continued)

C. Air (Continued)

	Yes	No
(5) Was equipment installed under New Source Review requirements?		

If yes, to which of the following is the equipment subject? Check the one that applies.

- ☐ Major source best available control technology (BACT) requirements under prevention of significant deterioration (PSD)
- ☐ Lowest achievable emission rate (LAER) requirements for nonattainment areas
- ☐ Minor source State or local new source review (NSR) requirements

	Yes	No
(6) Does the facility have a permit?		

Permit ID _____

If yes, does the permit cover any of the following activities? Check any that apply.

- ☐ Construction/operation of presses, control devices, distillation units, and proofing and/or binding equipment
- ☐ Operation of existing presses, control devices, distillation units, and/or proofing and binding equipment
- ☐ Modification of existing equipment or changing materials (e.g., inks, fountain solutions, cleaning solvents, etc.)

D. Emergency Planning and Community Right-To-Know

	Yes	No
(1) Does the facility have on-site any of the Extremely Hazardous Substances (EHS) in excess of the established threshold planning quantities?		

If yes, list substances.

	N/A	Yes	No
(2) If hazardous chemicals are present in excess of 10,000 lbs., have the material safety data sheets (MSDS) (or a list of chemicals) and chemical inventory forms been submitted to State and local emergency planning authorities and fire departments?			

I. GENERAL FACILITY INFORMATION (Continued)

D. Emergency Planning and Community Right-To-Know (Continued)

	N/A	Yes	No
(3) Were the State Emergency Response Commission (SERC) and Local Emergency Planning Committee (LEPC) notified of their presence for local planning purposes?			

	Yes	No
(4) Has the facility released an extremely hazardous substance (EHS) or a CERCLA hazardous substance in excess of the Superfund reportable quantity?		

	Yes	No
• If yes, was notification of the release provided?		

- To whom? _____
- Was notification oral or written? _____

	Yes	No
• Was oral notification followed up by written notification?		

	Yes	No
(5) Does the facility have Material Safety Data Sheets (MSDS) readily available for all hazardous chemicals used? (OSHA)		

E. EPCRA Section 313 – Toxic Release Inventory

	Yes	No
(1) Does the facility have ten or more full-time employees?		

	Yes	No
(2) Did the facility use more than 10,000 lbs. of at least one toxic chemical during a previous calendar year?		

	N/A	Yes	No
If yes, did the facility file a Section 313 Toxic Chemical Release Inventory Form R for the chemicals?			

I. GENERAL FACILITY INFORMATION (Continued)

F. Hazardous Wastes

	Yes	No
(1) Does the facility generate hazardous wastes from printing activities?		

	Yes	No
(2) Does the facility have an EPA ID No.?		

EPA ID No.: _____

	Yes	No
(3) Is the facility's waste determination method (i.e., to determine whether a waste is hazardous or nonhazardous) adequate?		

	Yes	No
(a) Does the facility determine if its waste is excluded from regulation under Part 261.4(b) (i.e., solid wastes which are not hazardous wastes, such as household waste)?		

	Yes	No
(b) If no, does the facility determine if the waste is listed in Part 261, Subpart D (examples of listed wastes typically found in the printing industry include tetrachloroethylene, methylene chloride, xylene, and acetone)?		

	Yes	No
If yes, does the facility determine if the waste has been excluded from the lists in Subpart D or Part 261.3 in accordance with 260.20 or 260.22 (which allows petitions to amend Part 261 to exclude a waste produced at a particular facility)?		

	Yes	No
If no, does the facility determine if the waste exhibits any of the characteristics specified in Part 261, Subpart C (for example, characteristics of ignitability, corrosivity, reactivity, and EP toxicity)?		

(4) Is the facility a

- ☐ Large quantity generator?
- ☐ Small quantity generator?
- ☐ Conditionally exempt small quantity (CESQG) generator?

I. GENERAL FACILITY INFORMATION (Continued)

F. Hazardous Wastes (Continued)

Notes to Inspector:

Check amounts in Table 1 to determine appropriate classification for facility.

Large quantity generator (LQG) generates 1,000 kg (2,200 lbs) of hazardous waste (HW) or more per month. The waste must be shipped in 90 days and there is no limit to the amount that may be accumulated.

Small quantity generator (SQG) generates between 100 kg (220 lbs) and 1,000 kg (2,200 lbs) nonacute HW in a calendar month. The waste must be shipped in 180 days and is limited to accumulating no more than 6,000 kg (13,200 lbs) HW on-site.

A conditionally exempt small quantity generator (CESQG) generates no more than 100 kg (220 lbs) HW in a calendar month and accumulates less than 1,000 kg (2,200 lbs) on-site; OR, generates less than 1 kg (2.2 lbs) acute HW in a calendar month and accumulates less than 100 kg (220 lbs) acute HW.

	N/A	Yes	No
(5) Excluding CESQGs, are the hazardous wastes at the facility consistent with generator notification records (i.e., has the facility notified the State or EPA of all generated wastes)?			

(6) What are the hazardous wastes management practices? Check all that apply.

On-site:
- Satellite accumulation ☐
- Container storage ☐
- Tank storage ☐
- Treatment ☐
- Disposal ☐
- Other ☐

I. GENERAL FACILITY INFORMATION (Continued)

F. Hazardous Wastes (Continued)

		Yes	No
(7)	If the facility ships hazardous wastes off-site, is a manifest system used?		

		Yes	No
(8)	Does the facility generate wastes that are restricted from land disposal (i.e., liquid hazardous wastes having a pH $\leq$ 2.0; liquid hazardous wastes containing halogenated organic compounds at $\geq$ 1,000 mg/L)?		
	If yes, does the facility comply with Part 268 for land disposal of restricted wastes?		

G. Toxic Substances Control

		Yes	No
(1)	Does the facility import any chemical substances (e.g., ink)?		

		N/A	Yes	No
	If yes, has the facility completed the appropriate certification statement?			

II. PROCESS EVALUATION

A. General Housekeeping/Materials Storage

> ***Note to Inspector:***
>
> *Check Table 1 (i.e., Summary of Wastes Generated, Quantity, and Disposal methods) to verify wastes generated as you complete this section of the checklist.*
>
> *Typical wastes generated include: shop towels, used solvent and ink containers, and stir sticks.*

(1) Note any potential or actual problems regarding housekeeping and storage (e.g., air emissions, hazardous and nonhazardous solid wastes, and wastewater).

		Yes	No
(2)	Is the shop clean and orderly to prevent accidents and spills?		

II. PROCESS EVALUATION (Continued)

A. General Housekeeping/Materials Storage (Continued)

(3) Are chemicals kept in covered containers to minimize losses from evaporation and spills?

Yes	No

(4) Does the facility use spigots and pumps when dispensing raw materials?

Yes	No

(5) Does the facility use funnels for transferring wastes to storage containers?

Yes	No

(6) Does the facility implement dry methods for cleanup whenever possible?

Yes	No

(7) Does the facility have a spill prevention plan?

Yes	No

Note to Inspector:

Some POTWs may require printing facilities to develop spill prevention (or slug control) plans that include the following:

- *Description of discharge practices, including non-routine batch discharges*
- *Description of stored chemicals*
- *Procedures for immediately notifying the POTW of slug discharges*
- *Procedures to prevent adverse impacts from spills*

(8) Are there any floor drains leading directly to the sewer where the solvent or ink is stored?

Yes	No

If yes, in the event of a spill, will contaminants enter the floor drains?

N/A	Yes	No

If yes, what is the characteristic of wastewater contained in the floor drains and where do the floor drains discharge?

II. PROCESS EVALUATION (Continued)

A. General Housekeeping/Materials Storage (Continued)

		Yes	No
(9)	Are the amounts of chemicals stored in the process areas minimized to encourage materials conservation?		

		Yes	No
(10)	Does the facility use a "first-in first-out" policy to avoid the expiration of raw materials?		

		Yes	No
(11)	Are infrequently used materials ordered in small containers?		

		Yes	No
(12)	Are frequently used materials ordered in large containers?		

		Yes	No
(13)	Does the facility store products in locations that will preserve their shelf life?		

		N/A	Yes	No
(14)	If materials have exceeded their shelf life, are alternative uses considered before discarding?			

		N/A	Yes	No
(15)	Does the facility purchase materials from manufacturers that will accept returned materials if shelf life is exceeded?			

II. PROCESS EVALUATION (Continued)

B. Image Processing

a. General

	Yes	No
(1) Is image processing done at the facility?		

Note to Inspector:

Check Table 1 (i.e., Summary of Wastes Generated, Quantity, and Disposal Methods) to verify wastes generated as you complete this section of the checklist.

Typical wastes from image processing include the following: used film, process solutions containing photographic chemicals (fixer and developer), and silver (dissolved from processing film).

Typical hazardous wastes generated from image processing include: developers and fixers. Most developers contain levels of hydroquinone. If disposed of as an unused product it may be defined as a hazardous waste in applicable State regulations due to the concentration of hydroquinone. If the hydroquinone is consumed during use and does not show up in used developer, it is not considered hazardous. Fixers which allow silver to dissolve out of the film and paper can contain up to 4,000 ppm silver. Any solutions containing silver at concentrations greater than 5 ppm are considered hazardous wastes.

In addition, some POTWs may have limits for silver in industrial discharges that are below 5 ppm. The facility should be aware of the applicable silver limits for its discharge.

(2) Note any potential or actual problems regarding image processing with respect to air emissions, nonhazardous and hazardous solid wastes, and wastewater.

II. PROCESS EVALUATION (Continued)

B. Image Processing (Continued)

b. Process Solutions

(1) List the chemicals/solutions and amounts used for:

	Type	Amount
Developer	_____	_____
Fixer	_____	_____
Stop Bath	_____	_____

(2) How are bath solutions currently monitored?

	Yes	No
(3) Are bath solutions changed on a set schedule?		

If yes, what is the schedule? _____

(4) With respect to the process bath, does the facility do any of the following:

	Yes	No
• Add ammonium thiosulfate to silver-contaminated baths to extend the allowable build-up of silver?		
• Prolong the potency of oxidation process baths by reducing their exposure to air?		
• Routinely monitor pH?		

	Yes	No
(5) Does the facility use squeegees following all processing solutions and washes in automatic processing machines?		

Note to Inspector:

Squeegees can significantly reduce the amount of solution carried out of the bath on the film. This reduces bath changeouts and replenishment rates. Types of squeegees include wiper blades, air squeegees, vacuum squeegees, wringersling squeegees, and rotary-buffer squeegees.

II. PROCESS EVALUATION (Continued)

B. Image Processing (Continued)

	Yes	No
(6) Does the facility use water recirculation units to reduce water use and wastewater generation?		

	N/A	Yes	No
(7) If the facility uses multiple rinses, is counter-current rinsing used?			

> ***Note to Inspector:***
>
> *If no, water recirculation units can reuse photoprocessing bath waters but filters from water recirculation units require disposal and may be considered hazardous wastes.*

	Yes	No
(8) Is an automatic film processor used?		

	N/A	Yes	No
If yes, is a continuous rinse used?			

How often are the processor's chemical tanks cleaned out? _____

c. Silver Recovery

(1) Does the facility use any of the following on-site silver recovery techniques to reduce silver concentrations in the discharge? (Check any that apply.)

- ☐ Electrolytic silver recovery
- ☐ Automatic recirculating silver recovery
- ☐ Metallic replacement canisters
- ☐ Ion exchange units
- ☐ Other (specify) _____

II. PROCESS EVALUATION (Continued)

B. Image Processing (Continued)

	Yes	No
(2) Does the facility ship wastes for off-site silver recovery?		

Note to Inspector:

Several on-site and off-site silver recovery methods are available.

- *On-site units include the following: electrolytic silver recovery (ESR) and metallic replacement units. Silver removed from the ESR and the metallic cartridges and fixer solutions are hazardous wastes and must be handled properly.*
- *Off-site silver recovery includes sending fixer bath solutions to a fixer recycler to recover silver and possibly regenerate the fixer or processing off-site cartridges from an on-site metallic replacement canister.*

d. Used Film

	Yes	No
(1) Does the facility recycle photographic film?		

	Yes	No
(2) Has the facility explored the use of silverless films?		

If yes, which type? (Check any that apply.)

- ☐ Diazo
- ☐ Photopolymer
- ☐ Electrostatic

	Yes	No
Has the use of these films reduced the amount of silver contaminated fixer or wash solutions?		

e. Innovative Technology

	Yes	No
(1) Has the facility considered installing waterless paper and film developing units to reduce the volume of fixer waste?		

II. PROCESS EVALUATION (Continued)

B. Image Processing (Continued)

	Yes	No
(2) Does the facility use electronic imaging?		

C. Stencil and Screen Preparation

a. General

Note to Inspector:

Check Table 1 (i.e., Summary of Wastes Generated, Quantity, and Disposal Methods) to verify wastes generated as you complete this section of the checklist.

Typical wastes from stencil and screen preparation include the following: waste emulsion, paper, spray adhesive, and wastewater.

(1) Note any potential or actual problems regarding stencil and screen preparation with respect to air emissions, hazardous and nonhazardous solid wastes, and wastewater.

II. PROCESS EVALUATION (Continued)

C. Stencil and Screen Preparation (Continued)

(2) What type of stencils are used?

- ☐ Direct coating stencil
- ☐ Indirect film stencil
- ☐ Capillary film stencil
- ☐ Hand cut stencil

b. Waste Solutions

(1) List the emulsion materials, adhesives, and any other solutions used in the stencil and screen preparation and note any hazardous materials they may contain.

D. Printing

a. General

Note to Inspector:

Check Table 1 (i.e., Summary of Wastes Generated, Quantity, and Disposal Methods) to verify wastes generated as you complete this section of the checklist.

Typical wastes from printing processes include the following: waste substrates, volatile organic compounds, waste ink, empty ink containers, and used plates.

Used printing inks can contain materials that would be considered hazardous wastes. For some chemicals the wastes are hazardous at any concentration while for other chemicals, the wastes are hazardous if they exceed specific regulatory limits.

Some agencies have requirements on the maximum VOC content for printing inks.

II. PROCESS EVALUATION (Continued)

D. Printing (Continued)

(1) Note any potential or actual problems regarding printing with respect to air emissions, hazardous and nonhazardous solid wastes, and wastewater.

b. Waste Ink and Empty Ink Containers

	Yes	No
(1) Do any of the inks contain hazardous materials such as solvents or heavy metals (e.g., fluorescent/bright-colored inks frequently contain higher concentrations of heavy metals)?		

List the hazardous constituents.

(2) Does the facility use any of the following less hazardous inks? (Check any that apply.)

- ☐ Water-based inks
- ☐ Ultraviolet curable inks
- ☐ Plastisol inks

(3) Does the facility use any of the following measures to reduce cleaning? (Check any that apply.)

- ☐ Use a standard ink sequence
- ☐ Run similar jobs on the same day or schedule jobs using light colored inks before darker ones
- ☐ Dedicate one press for inks containing hazardous pigments or solvents

II. PROCESS EVALUATION (Continued)

D. Printing (Continued)

(4) Does the facility do any of the following with unused portions of ink? (Check any that apply.)

- ☐ Save for house colors
- ☐ Offer customer discounts on leftover inks
- ☐ Use on donated jobs

If no, what do they do with the unused inks?

(5) Does the facility do any of the following with waste inks? (Check any that apply.)

- ☐ Reuse
- ☐ Recycle
- ☐ Return to the manufacturer

	Yes	No
(6) Does the facility purchase ink in bulk containers that may be returned to the supplier for refilling?		

	Yes	No
(7) Are inks removed from stir sticks with a scraper or spatula, rather than a towel?		

	Yes	No
(8) Are inks containing hazardous substances disposed of as hazardous waste?		

II. PROCESS EVALUATION (Continued)

D. Printing (Continued)

c. Substrate Wastes

		Yes	No
(1)	Is substrate use minimized by proper pre-production planning and lay-out?		

		Yes	No
(2)	Are waste paper and trash sent to a recycler?		

(3) What are the most common causes of misprints?

		Yes	No
(4)	Does the facility monitor press performance continuously to minimize bad runs and waste?		

E. Finishing

(1) What type of finishing operations are done at the facility?

> ***Note to Inspector:***
>
> *Check Table 1 (i.e., Summary of Wastes Generated, Quantity, and Disposal methods) to verify wastes generated as you complete this section of the checklist.*

(2) Note any potential or actual problems regarding finishing operations with respect to air emissions, nonhazardous and hazardous solid wastes, and wastewater.

II. PROCESS EVALUATION (Continued)

F. Cleaning/Screen Reclamation

a. General

Notes to Inspector:

Check Table 1 (i.e., Summary of Wastes Generated, Quantity, and Disposal Methods) to verify wastes generated as you complete this section of the checklist.

Typical wastes from cleaning/screen reclamation activities include: ink remover with residual ink, emulsion remover, haze remover, rags or shop towels containing cleaner and ink, empty solvent containers, and VOC emissions from cleaning solvents. All of these wastes are potentially hazardous wastes, if they contain substances with F-listed chemicals.

Tear-down and repair of equipment can produce large quantities of cleaning waste as compared to waste produced during normal operation.

	Yes	No
(1) Does the facility reclaim screens?		

(2) What type of other cleaning activities does the facility perform and how often are they performed?

(3) Note any potential or actual problems regarding cleaning/screen reclamation activities with respect to air emissions, nonhazardous and hazardous solid wastes, and wastewater.

II. PROCESS EVALUATION (Continued)

F. Cleaning/Screen Reclamation (Continued)

b. Waste Solutions

(1) Describe the various processes used in the facility to reclaim screens and list the cleaning solvents used in association with these processes.

Reclamation Task	Process Description	Cleaning Solvents Used
Ink Removal		
Emulsion Removal		
Haze Removal		
Other		

(2) List the types of solutions used for other cleaning purposes.

Yes	No

(3) Does the facility purchase screen reclamation solvents that do not contain F-listed wastes?

Note to Inspector:

F-listed wastes are chemicals designated by EPA to be hazardous wastes from non-specific source, and have an EPA hazardous waste number beginning with F. A summary of F-listed chemicals most commonly found in screen printing wastestreams is found in Footnote 1 of Table 1 in the main text. The complete list of chemicals and their corresponding hazardous waste numbers are in §261.31 of Title 40 of the Code of Federal Regulations.

Yes	No

(4) Has the facility worked with its vendor to find the lowest VOC solvents that work effectively?

Yes	No

(5) Has the facility tested more dilute solutions of cleaning solutions to determine whether they would be equally effective?

II. PROCESS EVALUATION (Continued)

F. Cleaning/Screen Reclamation (Continued)

		Yes	No
(6)	Does the facility have a solvent management plan to reduce solvent waste at the facility?		
(7)	Are cleaning chemicals applied to the screen evenly with a low volume method, such as an adjustable spray nozzle and a brush, rather than being hosed on?		
(8)	Are "catching frames" installed behind spray nozzles to collect excess cleaning solvent for reuse?		
(9)	Is a scraper used to remove as much excess ink from a used screen as possible before a chemical ink remover is applied?		
(10)	Are screens reclaimed promptly after the printing run to facilitate removal of ink and emulsion, and to reduce the chance that a caustic haze remover will be required?		
(11)	Has the facility attempted the application of screen degreasers and ink degradants before the emulsion remover to avoid the use of haze remover?		
(12)	If haze remover is required, is it applied only to the part of the screen that is stained?		
(13)	Does the facility have solvent containers or tanks?		
	If yes, are solvent container lids tight fitting and in place when not in use?		

II. PROCESS EVALUATION (Continued)

F. Cleaning/Screen Reclamation (Continued)

	N/A	Yes	No
(14) Are solvent tanks equipped with emission control equipment?			

If yes, specify.

	Yes	No
(15) Are spent solvents separated to facilitate recycling or proper disposal?		

If so, how are they separated?

- ☐ Hazardous/nonhazardous
- ☐ Chlorinated/nonhazardous
- ☐ Other: _____

(16) How are waste solvents handled? (Check any that apply.)

- ☐ Discharged to drains
- ☐ Captured as liquid
- ☐ Absorbed with rags, shop towels, or other absorbent materials

c. Shop Towels

(1) How are shop towels handled? (Check one that applies.)

- ☐ Washed on premises
- ☐ Picked up by commercial laundry: _____ (name of laundry)

	Yes	No
(2) Does the facility use towels as long as possible before discarding or laundering?		

II. PROCESS EVALUATION (Continued)

F. Cleaning Screen Reclamation (Continued)

	Yes	No
(3) Are used shop towels stored in closed, fire-resistant containers?		

	Yes	No
(4) Does the facility implement procedures to remove excess solvents or inks in the rags so they can be cleaned by an industrial laundry?		

	Yes	No
Is the recovered solvent reused?		

Note to Inspector:

A variety of approaches can be used to minimize the amount of solvents or inks in rags. These include:

- *Changing cleanup procedures so that solvent levels are kept to a minimum in the rags*
  - *Use practices that limit the worker's ability to soak rags in solvent (plunger cans, squeeze bottles, daily solvent allocations, directly pour solvent waste into labeled drums, etc.)*
- *Developing a procedure to separate a majority of the ink and solvent from soaked rags (centrifugal extractor or wringer)*

d. Innovative Technology

	Yes	No
(1) Does the facility reuse or recycle solvents?		

If yes, how is it reused or recycled?

II. PROCESS EVALUATION (Continued)

F. Cleaning/Screen Reclamation (Continued)

(2) If solvents are recycled on-site:

Does the solvent recycling process generate cooling water?

N/A	Yes	No

What procedures are used to ensure cooling water is not contaminated from equipment leaks?

(3) Does the facility use a high-pressure water blaster in the ink removal and emulsion removal process to reduce the amount of waste chemicals generated?

Yes	No

(4) Does the facility use fully enclosed automatic screen washers to reduce atmospheric VOC emissions, conserve solvent, and protect workers from exposure to hazardous chemicals?

Yes	No

(5) Has the facility tested baking soda sprays in the removal of ink and emulsion?

Yes	No

(6) Has the facility used any of the following emerging screen reclamation technologies?

	Yes	No
Media blasting		
Pulse light energy technologies		
Stripping techniques		
Emulsion chemistry		

If yes, describe the technology and any issues associated with the use.

III. WASTE HANDLING AND MANAGEMENT

A. Wastewater Management

(1) List the expected pollutants in the facility's wastewater discharge.

(2) Does the POTW have sewer use limits for any of these pollutants?

Yes	No

If yes, list the pollutants.

(3) Does the facility have a current wastewater discharge permit?

N/A	Yes	No

If no, has the facility applied for a permit?

N/A	Yes	No

(4) If the facility has a wastewater discharge permit, complete the following:

List the parameters limited in the facility's permit.

Parameter	Limit

III. WASTE HANDLING AND MANAGEMENT (Continued)

A. Wastewater Management (Continued)

Is the facility in compliance with the following requirements in its permit?

	N/A	Yes	No
Permit limits			
Sampling location			
Sampling frequency			
Parameters analyzed			
Analytical methods			
Reporting			
Recordkeeping			

If no is checked for any of the above items, describe the potential or actual noncompliance with specific permit requirements.

(5) Describe any observable impact of the wastewater discharge. (For example, is the discharge murky or are there any unusual odors?)

(6) Describe any wastewater treatment employed at the facility. (Note: This does not include any recovery systems.)

	Yes	No
(7) Is wastewater treatment sludge generated on-site?		

If yes, how is it disposed?

III. WASTE HANDLING AND MANAGEMENT (Continued)

A. Wastewater Management (Continued)

If applicable, where does the water, removed from the sludge dewatering process, return to the facility?

Yes	No

(8) For facilities that discharge to POTWs, did the facility notify the POTW if any substances discharged by the facility would be a hazardous waste under 40 CFR Part 261?

B. Hazardous Wastes Management

Yes	No

(1) Is hazardous waste accumulated in containers at or near the point of generation (i.e., in the process areas)?

N/A	Yes	No

If yes, is the capacity of the containers less than 55 gallons or is the quantity of wastes accumulated less than 55 gallons?

Yes	No

Is excess accumulation removed within 3 days?

Yes	No

(2) Does the facility have a hazardous waste storage area?

Yes	No

(3) Are the waste storage containers indoors or in covered areas to prevent moisture from seeping in?

III. WASTE HANDLING AND MANAGEMENT (Continued)

B. Hazardous Wastes Management (Continued)

(4) Are the hazardous wastes containers managed as follows? (Check all that apply.)

- ☐ Containers in good condition (no rusting, defects, or evidence of leaks)
- ☐ Containers properly labeled as hazardous type of waste and start date of accumulation
- ☐ Containers compatible with waste
- ☐ Containers closed when not in use
- ☐ Containers opened, handled, and stored in a manner not to cause a leak
- ☐ Containers storing incompatibles kept separate
- ☐ Containers appropriately stored for:
  - ☐ 90 days or less
  - ☐ 180 days or less
  - ☐ 270 days or less

For items not marked, please describe the problem.

	Yes	No
(5) Is there adequate secondary containment capacity for free liquid wastes stored in a storage area?		

	Yes	No
(6) Are any hazardous wastes shipped off-site?		

	Yes	No
If yes, does the facility use a manifest system?		

III. WASTE HANDLING AND MANAGEMENT

B. Hazardous Wastes Management (Continued)

(7) Do the manifest records contain the following? Check all that apply.

- ☐ Generator EPA ID number
- ☐ Generator name, address, phone number
- ☐ Transporter name, EPA ID number
- ☐ Designate facility name, address, phone number, and EPA ID number
- ☐ Alternate facility identified
- ☐ Five-digit document number
- ☐ DOT shipping name, hazard class, waste code, and RQ
- ☐ Containers: number, type, quantity, unit wt/vol
- ☐ Proper certification, including waste minimization
- ☐ Dates and signatures

	Yes	No
(8) Have exception reports been required?		

	N/A	Yes	No
If yes, have they been submitted?			

	N/A	Yes	No
(9) Are manifest records maintained for 3 years?			

	N/A	Yes	No
(10) If wastes are reclaimed, does facility have a copy of the contractual agreement with reclaimer?			

III. WASTE HANDLING AND MANAGEMENT

B. Hazardous Wastes Management (Continued)

	N/A	Yes	No
(11) Has the facility determined and submitted notifications of hazardous waste restricted from land disposal?			

If yes, do the notifications contain the following? (Check all that apply.)

- ☐ EPA hazardous waste number (e.g., F002)
- ☐ The corresponding treatment standard(s) [see 40 CFR 268.7(a)(l)(ii) for details]
- ☐ The manifest number associated with the shipment of waste
- ☐ Waste analysis data, where available

	N/A	Yes	No
(12) If land disposal restricted wastes are treated on-site, does facility have records documenting that wastes meet land disposal restriction treatment standards?			

C. Air

	Yes	No
(1) Does the facility have any of the air pollution control technologies?		

If yes, check any that apply.

- ☐ Incinerator
- ☐ Carbon Absorption Unit
- ☐ Condenser
- ☐ Ventilation Capture System

III. WASTE HANDLING AND MANAGEMENT

C. Air (Continued)

Note to Inspector:

Air pollution control technologies include the following:

- *Incinerators (including catalytic) – Incineration of exhaust gas is widely used in the printing industry. Often, heat is recycled back into the building (i.e., heat-set offset) or process dryers. Compliance is monitored by incineration temperature or change in temperature across the catalytic surface.*
- *Carbon Absorption – Carbon beds capture exhaust VOCs which are recovered periodically through a steam stripping process. Presses/facilities utilizing a single solvent can efficiently recover solvent for on-site use. This method is typically used on larger presses with hydrocarbon monitors to confirm efficiency.*
- *Condensers – Refrigerated coils are used to cool exhaust gas and cause solvent to condense for recovery. Condensers are not widely used in the graphics arts industry.*

(2) Does the facility have an air permit?

Yes	No

If no, has the facility applied for a permit?

Yes	No

(3) If the facility has an air permit, is it in compliance with the following requirements in its permit?

	N/A	Yes	No
Emissions limits			
Emissions monitoring			
Analytical methods			
Reporting			
Recordkeeping			

Other (describe): _____

(4) If no is checked for any of the above items, describe any actual or potential violations with specific permit requirements.

APPENDIX B

MULTIMEDIA COMPLIANCE/POLLUTION PREVENTION ASSESSMENT REPORT FORM FOR SCREEN PRINTING FACILITIES

FACILITY NAME AND LOCATION:

MAILING ADDRESS:
(if different)

FACILITY CONTACT(S):

Name	Title/Affiliation	Phone Number

ASSESSMENT DATE:

INSPECTOR(S):

Name	Title/Affiliation	Phone Number

REASON FOR VISIT:

AREAS VISITED:

DATE FORM COMPLETED:

I. GENERAL FACILITY DESCRIPTION

Provide a general description of the facility (e.g., building age, length of business at this location, previous owners/operators at the site, printing capacity, brief description of processes, brief overview of wastes generated and disposal methods used, and status of P2 implementation efforts).

II. COMPLIANCE ASSESSMENT

Wastewater

Describe any observed or potential violations:

Referral to other program office _____

Air Quality

Describe any observed or potential violations:

Referral to other program office _____

Emergency Planning and Community Right-to-Know Act (EPCRA)

Describe any observed or potential violations:

Referral to other program office _____

Hazardous Waste [Resource Conservation and Recovery Act (RCRA)]

Describe any observed or potential violations:

Referral to other program office _____

Toxic Substances Control

Describe any observed or potential violations:

Referral to other program office _____

III. POLLUTION PREVENTION (P2) AND INNOVATIVE TECHNOLOGY OPPORTUNITIES IDENTIFIED

List each waste at the facility with any associated P2 and innovative technology opportunities. Use additional sheets for more information.

PROCESS - IMAGE PROCESSING

Raw Materials or Waste Description	Pollution Prevention and Innovative Technology Opportunities

PROCESS - STENCIL AND SCREEN PREPARATION

Raw Materials or Waste Description	Pollution Prevention and Innovative Technology Opportunities

III. POLLUTION PREVENTION (P2) AND INNOVATIVE TECHNOLOGY OPPORTUNITIES IDENTIFIED (Continued)

List each waste at the facility with any associated P2 and innovative technology opportunities. Use additional sheets for more information.

PROCESS - PRINTING

Raw Materials or Waste Description	Pollution Prevention and Innovative Technology Opportunities

PROCESS - FINISHING

Raw Materials or Waste Description	Pollution Prevention and Innovative Technology Opportunities

III. POLLUTION PREVENTION (P2) AND INNOVATIVE TECHNOLOGY OPPORTUNITIES IDENTIFIED (Continued)	
PROCESS - SCREEN RECLAMATION/CLEANING	
Raw Materials or Waste Description	**Pollution Prevention and Innovative Technology Opportunities**
PROCESS - OTHER	
Raw Materials or Waste Description	**Pollution Prevention and Innovative Technology Opportunities**

IV. CONCLUSIONS AND RECOMMENDED FOLLOW UP

A. Compliance Violations and/or Issues [add regulatory references (i.e., 40 CFR 261.30)].

B. Potential P2 Opportunities and Innovative Technologies. (These are only suggestions and not regulatory requirements.)

C. Follow-up Responses to Compliance Questions Asked During On-Site Assessment. (This section should include responses to compliance questions asked during the on-site assessment that the inspector was unable to answer.)

APPENDIX C

ANNOTATED BIBLIOGRAPHY OF SELECTED REFERENCES

APPENDIX C

ANNOTATED BIBLIOGRAPHY OF SELECTED REFERENCES

This is not meant to be a comprehensive list of pollution prevention resource materials on the screen printing process. Rather, it contains a range of references that could be used for initial review by the inspector. Many of these documents also contain reference lists. In addition, discussion of specific pollution prevention techniques and innovative technologies, or mention of trade names of commercial products, in these documents does not constitute an endorsement or recommendation for use by EPA.

Alaska Health Program. April 1991. Waste Reduction Assistance Program. *Waste Reduction Guide: Printing Business.*

Manual designed to assist the printing business in identifying and implementing waste reduction opportunities.

Available From: **Pollution Prevention Clearinghouse**
Environmental Protection Agency
401 M Street, SW (3401)
Washington, DC 20460
(202) 260-1023

Aspesi, Luigi. February 1987. *UV Inks: Their use in four color process screen printing using UCR.* American Ink Maker. Volume 65, No. 2.

Journal article that presents the advantages of the Under Colour Removal (UCR) system in four color process screen printing using UV inks.

California Department of Health Sciences. May 1988. *Waste Audit Study: Commercial Printing Industry*. Prepared for the Alternatives Technology Section, Substances Control Division, California Department of Health Sciences. Sacramento, CA.

Study identifying waste minimization techniques available to printers. Recommendations and findings are included as well as checklists that can be used by printers to perform their own waste audits.

Available From: **California Department of Health**
Department of Toxic Substances Control
Office of Pollution Prevention Technology and Development
Document #303—Limited to existing stock
(916) 324-1087

Connecticut Technical Assistance Program. August 1992. *On-Site Waste Ink Recycling*. The Hartford Courant. Hartford, CT.

In-depth case study of how one large newspaper developed a waste ink recycling program. The project addressed product quality, waste reduction, and the economic issues involved in recycling press ink. Information on testing and comparison of virgin and recycled ink are documented. Economic information regarding the resulting cost savings is provided.

Available From: **CONNTAP**
50 Columbus Blvd., 4th Floor
Hartford, CT 06106
(203) 241-0777

Easton, J.R. and J.R. Provost. "Pollution Control and the Textile Printer." International Dyer, Textile Printer, Bleacher and Finisher, Sept. 1993.

This article presents several applications of new technologies that could minimize pollution in the textile printing industry. Methods discussed include computerized ink jet print process as a substitute for screen printing and integration of computer systems into the color kitchen process to reduce waste.

Hawaii Department of Health. Solid and Hazardous Waste Branch. September 1993. Hazardous Waste Minimization News: *Waste Minimization in Action - Printing Operations*.

Newsletter featuring tips and ideas on reducing hazardous wastes generated at printing operations.

Available From: **Hawaii Department of Health**
Solid and Hazardous Waste Branch
919 Ala Moana Blvd., Rm. 212
Honolulu, HI 96814
(808) 586-4373

Iowa Waste Reduction Center. Undated. *Eliminating the Screen Printing Photographic Prepress: A Case Study in Pollution Prevention and Industry Readiness.*

An analysis of current practices in the screen printing industry with regard to positives generation and waste disposal options for screen printing prepress operations.

Available From: **Iowa Waste Reduction Center**
University of Northern Iowa
75 Biology Research Complex
Cedar Falls, IA 50614-0815
(319) 273-2079

Jones, Alan. June 1985. *Container decoration: substrates and inks.* Screen Printing, Vol. 75, No. 6.

This article discusses the evolution and present state of the decoration of plastic bottles by the screen printing process. The advantages of UV curing inks are presented.

King County (Washington) Local Hazardous Waste Management Program. *Screen Print Project: Screen Printing Process (with Flow Diagram).* King County, Washington.

This brief guide describes the screen printing processes including art preparation, screen preparation, production, clean-up activities. The materials used and the wastes generated at each step of the process are identified. A flow diagram is included to show a schematic representation of the screen printing process, including the raw material inputs and waste outputs.

Available from: **Local Hazardous Waste Management Program**
(King County, Washington)
(206) 689-3090

King County (Washington) Local Hazardous Waste Management Program. May 1994. *Screen Printers: Waste Management Guide.* King County, Washington.

A guidebook that provides screen printers in King County with information about the best ways to manage and dispose of aerosol cans, waste ink, shop towels, photo-processing solutions, wastewater, and waste solvent.

Available from: **Local Hazardous Waste Management Program (King County)**
(206) 689-3090

Kinter, Marcia. August 1989. *The Movement Towards Clean Air: What it Means for the Screen Printer.* Screen Printing, Vol. 79, No. 9.

This article presents information to educate the screen printing industry by exploring the Clean Air Act and discussing the important principles involved. In addition, this article aims to help the screen printer understand why the industry has been targeted to reduce its emissions of pollutants.

New York State Department of Environmental Conservation. September 1991. *Hazardous Waste Management for Printers.*

Pamphlet providing information regarding hazardous wastes, waste reduction and recycling strategies, information available from the State of New York, and information on how to categorize waste streams (i.e., hazardous, nonhazardous).

Available From: **New York State Department of Environmental Conservation**
Division of Hazardous Substance Regulation
50 Wolf Road
Albany, NY 12233-7253
(212) 637-4100

Screen Printing Association International. Undated. *Government Resource Book.* Screen Printing Association International.

This document provides the screen printer with overviews of the Federal Clean Air Act, the safety and health regulations, the Safe Drinking Water Act, the various industrial waste operations, and the labeling of products using ozone depleting substances.

Available From: **Screenprinting and Graphic Imaging Association International**
10015 Main Street
Fairfax, VA 22031
(703) 385-1335

State of Montana, Department of Health and Environmental Sciences. June 1988. *The Small Quantity Generator's Handbook for Managing RCRA Wastes - Printing and Publishing.*

This is a handbook developed for the printing and publishing industry to comply with RCRA requirements. The manual also provides insight into waste management strategies for minimizing waste quantities. Information was compiled through site visits to various printing shops. The handbook also summarizes the RCRA regulations that apply to printers.

Available From: **State of Montana**
Division of Wastes
(406) 444-1430

Also available is a 1995 Updated Version: *Small Business Handbook for Managing Hazardous Wastes.*

Tellus Institute. June 1995. *User's Guide: P2/FINANCE for Screen Printers (Version 1.0).* Boston, MA.

This User's Guide introduces P2/FINANCE for Screen Printers (Version 1.0) software system, a tool designed to assist you in evaluating the profitability of pollution prevention investments. This guide offers step-by-step instructions for installing and using the P2/FINANCE-SP system. P2/FINANCE-SP was designed specifically for screen printers and includes a Master List of costs and revenues specific to the basic screen printing processes. This system also allows you to expand the list of costs and revenues so that the software can be tailored to your business's operations. Developed by Tellus Institute with funding from the U.S. EPA's Design for the Environment Program in cooperation with the Screenprinting and Graphic Imaging Association International.

Available from: **Tellus Institute**
11 Arlington Street
Boston, MA 02116-3411
(617) 266-5400

U.S. Environmental Protection Agency. January 1976. *Environmental Aspects of Chemical Use In Printing Operations*. Office of Toxic Substances. Washington, DC. EPA-560/1-75-005 [call # PB251406].

This document contains the proceedings for the conference on " Environmental Aspects of Chemical Use in Printing Operations." Papers presented covered types of printing processes, emissions regulations, and health hazards from printing effluents.

Available From: **National Technical Information Service**
5285 Port Royal Road
Springfield, VA
(703) 487-4650

U.S. Environmental Protection Agency. October 1983. *Summary of Available Information on the Levels and Control of Toxic Pollutants Discharges in the Publishing and Printing Point Source Category*. Effluent Guidelines Division. Washington, DC. EPA 440/1-83-400 [call # PB92231703].

Summary of information used to develop the effluent guidelines for printers. Includes information on data gathering, water usage, toxic pollutant discharge data, and control and treatment technologies employed in printing industry.

Available From: **National Technical Information Service**
5285 Port Royal Road
Springfield, VA
(703) 487-4650

U.S. Environmental Protection Agency. January 1988. *Title III Section 313 Release Reporting Guidance; Estimating Chemical Releases From Printing Operations*. Office of Pesticides and Toxic Substances. Washington, DC. EPA 560/4-88-004b [call # PB93205979].

This document was designed to assist printers in completion of Part III (Chemical Specific Information) of the Toxic Chemical Release Inventory Reporting Form. General information on toxic chemicals used, process wastes generated, and examples of data needs and methodologies are included.

Available From: **National Technical Information Service**
5285 Port Royal Road
Springfield, VA
(703) 487-4650

U.S. Environmental Protection Agency. October 1989. *Pollution Prevention in Printing and Allied Industries: Saving Money Through Pollution Prevention* (Draft). ORD Pollution Prevention Office, Washington, DC.

Intended to provide a brief introduction to pollution prevention, including what it is, how it can help save money, and where you can get additional assistance. Example technical options available to printing and allied facilities are included.

Available From: **Pollution Prevention Clearinghouse**
Environmental Protection Agency
401 M Street, SW (3401)
Washington, DC 20460
(202) 260-1023

U.S. Environmental Protection Agency. Office of Pollution Prevention. November 1989. *Case Studies from the Pollution Prevention Information Clearinghouse (PPIC): Printing*. Washington, DC.

Provides short (1 - 2 page) case studies of pollution prevention activities conducted at printing establishments. Details regarding costs to implement practices and cost savings are presented.

Available From: **Pollution Prevention Clearinghouse**
Environmental Protection Agency
401 M Street, SW (3401)
Washington, DC 20460
(202) 260-1023

U.S. Environmental Protection Agency. August 1990. *Guides to Pollution Prevention: The Commercial Printing Industry*. Office of Research and Development. Washington, DC. EPA/625/7-90/008.

This guide was designed to provide commercial printers with guidelines and options to minimize both hazardous and non-hazardous wastes. Worksheets for use in developing waste minimization options for a facility are included.

Available From: **Center for Environmental Research Information**
Document Distribution Center (G-72)
26 West Martin Luther King Drive
Cincinnati, OH 45268
(513) 569-7562

U.S. Environmental Protection Agency. September 1991. *Achievements in Source Reduction and Recycling for Ten Industries in the United States*. Office of Research and Development, Washington, DC. EPA/600/S-91/051 [call # PB92137470].

A collection of source reduction and recycling case studies presented to U.S. EPA as success stories. The document includes two studies related to printing processes.

Available From: **National Technical Information Service**
5285 Port Royal Road
Springfield, VA
(703) 487-4650

U.S. Environmental Protection Agency. July 1993. *Design for the Environment Printing Project*. Office of Pollution Prevention and Toxics. Washington, DC. EPA 744-F-93-003.

A fact sheet describing the Design for the Environment Printing Project.

Available From: **Pollution Prevention Clearinghouse**
Environmental Protection Agency
401 M Street, SW (3401)
Washington, DC 20460
(202) 260-1023

U.S. Environmental Protection Agency. March 1994. *Federal Environmental Regulations Potentially Affecting the Commercial Printing Industry*. Office of Pollution Prevention and Toxics. EPA 744-B-94-001.

This document presents a discussion of Federal environmental statutes potentially affecting the commercial printing industry. It provides an overview of the regulations and the specific chemicals used in the industry that may trigger particular regulatory requirements. This

document is intended for information purposes only and is not an official EPA guidance document.

Available From: **Pollution Prevention Clearinghouse**
Environmental Protection Agency
401 M Street, SW (3401)
Washington, DC 20460
(202) 260-1023

U.S. Environmental Protection Agency. June 1994. *Abstracts of Pollution Prevention Case Study Sources*. Office of Pollution Prevention and Toxics. Washington, DC. EPA 742-R-94-001.

This document provides sources for pollution prevention case studies. It is intended to serve as a reference guide for locating pollution prevention case studies with economic information. Each source listing contains a short description of the contents, a contact name and telephone number, and a price for the document.

Available From: **Pollution Prevention Clearinghouse**
Environmental Protection Agency
401 M Street, SW (3401)
Washington, DC 20460
(202) 260-1023

U.S. Environmental Protection Agency. June 1994. *Printing Industry and Use Cluster Profile.* U.S. Environmental Protection Agency. Office of Pollution Prevention and Toxics. Washington, DC 20460. EPA 744-R-94-003.

This report presents a profile of the printing industry, defines a use cluster, and presents an overview of the chemicals, technologies, and processes used in the printing industry.

Available from: **Pollution Prevention Information Clearinghouse**
Environmental Protection Agency
401 M Street, SW
Washington, DC 20460
(202) 260-1023

U.S. Environmental Protection Agency. June 1994. *Summary of Focus Group Discussion with Screen Printers and Lithographers for the Design for the Environment Printing Project.* Office of Pollution Prevention and Toxics. Washington, DC. EPA 742-R-94-004.

This report presents the methodology used to conduct the focus groups, provides an overview of findings, and then summarizes the findings of screen printing focus groups and lithography focus groups separately. Individual summaries of each focus group, the facilitator's guides and the "mockups" presented at the focus groups are attached as appendices.

Available From: **Pollution Prevention Clearinghouse**
Environmental Protection Agency
401 M Street, SW (3401)
Washington, DC 20460
(202) 260-1023

U.S. Environmental Protection Agency. September 1994. *Design for the Environment. Cleaner Technologies Substitutes Assessment: Screen Printing Industry, Screen Reclamation Use Cluster (Draft).* Office of Pollution Prevention and Toxics. Washington, DC. EPA 744-R-94-005.

This document presents the Cleaner Technologies Substitutes Assessment (CTSA) for screen printing screen reclamation. Developed by the Design for the Environment for use by industry, this CTSA focuses on the use cluster of screen reclamation, which is a process, rather than a specific set of chemicals. The goal of the CTSA is to offer a complete picture of environmental impacts, cost and performance issues associated with each option in order to allow for an informed decision about which alternative is best for a particular situation.

Available from: **Pollution Prevention Information Clearinghouse**
Environmental Protection Agency
401 M Street, SW
Washington, DC 20460
(202) 260-1023

U.S. Environmental Protection Agency. October 1994. *Design for the Environment Printing Project. Screen Printing Case Study 2: Technology Alternatives for Screen Reclamation (Draft).* Office of Pollution Prevention and Toxics. Washington, DC.

A fact sheet describing the Design for the Environment Screen Printing Case Study 2 on technology alternatives for screen reclamation. This case study presents descriptions of two commercially available technologies, a description of a technology now under development, and comparative cost, performance, and risk information for three reclamation technologies.

Available From: **Pollution Prevention Information Clearinghouse**
Environmental Protection Agency
401 M Street, SW
Washington, DC 20460
(202) 260-1023

U.S. Environmental Protection Agency. December 1994. *Design for the Environment Printing Project. Screen Printing Case Study 4: Work Practice Alternatives for Screen Reclamation (Draft)*. Office of Pollution Prevention and Toxics. Washington, DC. EPA 742-F-95-003.

A fact sheet describing the Design for the Environment Screen Printing Case Study 4 on work practice alternatives for screen reclamation. This case study highlights simple changes in work practices in the screen reclamation process that resulted in significant environmental benefits in terms of costs, environmental impacts, and worker exposure.

Available From: **Pollution Prevention Information Clearinghouse**
Environmental Protection Agency
401 M Street, SW
Washington, DC 20460
(202) 260-1023

U.S. Environmental Protection Agency. December 1994. *Design for the Environment Printing Project. Screen Printing Case Study 5: Chemical Alternatives for Screen Reclamation (Draft)*. Office of Pollution Prevention and Toxics. Washington, DC. EPA 742-F-95-004.

A fact sheet describing the Design for the Environment Screen Printing Case Study 5 on chemical alternatives for screen reclamation. This case study highlights one of eleven alternative systems demonstrated in the DfE project, describing performance evaluations, health and environmental risks, and costs of the alternative system.

Available From: **Pollution Prevention Information Clearinghouse**
Environmental Protection Agency
401 M Street, SW
Washington, DC 20460
(202) 260-1023

U.S. Environmental Protection Agency. August 1995. *Multimedia Compliance/Pollution Prevention Assessment Guidance for Lithographic Printing Facilities.* U.S. Environmental Protection Agency, Office of Enforcement and Compliance Assistance.

U.S. Environmental Protection Agency. August 1995. *EPA Office of Compliance Sector Notebook Project - Profile of the Printing and Publishing Industry*. Office of Compliance. Washington, DC. EPA/310-R-95-014.

This document is part of the EPA Office of Compliance's Sector Notebook Project. It provides a variety of summary information for the printing and publishing industry, including general industry information, a description of industrial processes, pollution issues, and the Federal statutory and regulatory framework.

Available From: **Superintendent of Documents**
U.S. Government Printing Office
Washington, DC 20402
(202) 512-1800

U.S. Environmental Protection Agency. Undated. *Design for the Environment Printing Project: Case Study*. Design for the Environment Program; Office of Pollution Prevention and Toxics. EPA 744-K-93-001.

First in the series of case studies that illustrates the Design for the Environment theme. The study describes the successful pollution reduction program of a printing company in Minnesota. The company searched for safer alternatives to managing solvents and wipes.

The case study explains the methodical evaluation of the problem leading to solutions aimed at reducing the creation of pollutants at their source.

Available From: **Pollution Prevention Clearinghouse**
Environmental Protection Agency
401 M Street, SW (3401)
Washington, DC 20460
(202) 260-1023

U.S. Environmental Protection Agency. Undated. *Design for the Environment Printing Project. Screen Printing Case Study 2: Reducing the Use of Reclamation Chemicals in Screen Printing (Draft)*. Office of Pollution Prevention and Toxics. Washington, DC. EPA 744-F-93-015.

A fact sheet describing the Design for the Environment Screen Printing Case Study 2 on reducing the use of reclamation chemicals in screen reclamation. This case study shows (1) how a self-audit of ink remover products used in screen cleaning led to the substitution of more environmentally appropriate solvents, (2) how using a still to recover and reuse ink cleaning solvent saved the money, and (3) how using a high-pressure water blaster and changing product application techniques allowed the company to decrease its use of reclamation chemicals.

Available From: **Pollution Prevention Information Clearinghouse**
Environmental Protection Agency
401 M Street, SW
Washington, DC 20460
(202) 260-1023

U.S. Environmental Protection Agency. Undated. *Printing and Publishing Information Packet.*

Compilation of information on printing and publishing.

Available From: **Pollution Prevention Clearinghouse**
Environmental Protection Agency
401 M Street, SW (3401)
Washington, DC 20460

Venell, Susan. August 1985. *Water-Based Inks: Why The Diluted Response?* Screen Printing, Vol. 75, No. 8.

This article discusses why water-based inks, although readily available to the screen printing industry, have not been widely accepted. Problems associated with water-based screen printing and possible activities hindering acceptance of water-based inks are discussed.

Virginia Department of Environmental Quality. September 1993. *Printers Win Through Pollution Prevention* (Video). Waste Reduction Assistance Program.

"Real Life" pollution prevention options for printers are highlighted in this video. A list of vendors and associations that may provide information beneficial to printers accompanies the video.

Available From: **Waste Reduction Assistance Program**
Virginia Department of Environmental Quality
Office of Pollution Prevention
P.O. Box 10009
Richmond, VA 23240-0009
(804) 762-4344

Virginia Waste Reduction Assistance Program. 1991. *Waste Reduction Fact Sheet: Waste Reduction for the Commercial Printing Industry*. Vol. 1, Issue 2.

Short fact sheet on steps to reduce waste, and the toxicity of waste streams from printers.

Available From: **Virginia Department of Environmental Quality**
Office of Pollution Prevention
P.O. Box 10009
Richmond, VA 23240-0009
(804) 762-4344

Washington State Department of Ecology. September 1994. *Environmental Management and Pollution Prevention: A Guide for Screen Printers.* Washington State Department of Ecology Environmental Management and Pollution Prevention.

A guide focusing on (1) encouraging pollution prevention as a first step toward better environmental management on the print shop level and (2) educating the printing industry on applicable Federal, State, and local environmental requirements and options available to meet those requirements.

Available from: **Department of Ecology**
Eastern Regional Office
North 4601 Monroe, Suite 202
Spokane, WA 99205-1295
(509) 456-2926